STANDARD PRACTICE
in
SHEET METAL WORK

A Manual of Recommended Practice

MICHIGAN
CHAPTER
SHEET METAL
AND
AIR CONDITIONING
CONTRACTORS
NATIONAL ASSOCIATION, INC.

M. D. Denniston

MEMBER
SHEET METAL
AND
AIR CONDITIONING
CONTRACTORS
NATIONAL ASSOCIATION, INC

-- MICHIGAN CHAPTER --

Sheet Metal and Air Conditioning Contractors National Association, Inc.

This "LIBRARY OF SHEET METAL MANUALS" consisting of:

1. Architectural Sheet Metal Work
2. Mechanical Sheet Metal Work
3. Industrial Ventilation

is presented to you with the compliments of the members of the "MICHIGAN CHAPTER OF SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, INC."

These manuals are designed to provide educational and reference programs with the hope that the best in workmanship, trade knowledge and contract performance may always be available to designers and owners of buildings.

This library will also be available to every Sheet Metal Contractor who is identified with "THE MICHIGAN CHAPTER."

From time to time, as any new information becomes available, you will be provided with additional pages to insert in the appropriate binder.

Also with this binder you will find a list of contracting firms who are members of this "MICHIGAN CHAPTER." If you should at any time have a question relative to these manuals you may call the contractor nearest you who is listed in this membership roster and he will be anxious to explain it to you.

We hope that you will find these manuals helpful and instructive.

Sincerely yours,

MICHIGAN CHAPTER OF S.M.A.C.N.A.

MEMBERS OF THE "MICHIGAN CHAPTER"
Sheet Metal and Air Conditioning Contractors National Association, Inc.

BATTLE CREEK AREA

F. & A. Fabricating Company
104 Arbor St., Battle Creek, Michigan

Murry Engineering Company
482 W. Michigan Ave., Battle Creek, Michigan

Morse Brothers Sheet Metal
742 Capitol Ave., N.W., Battle Creek, Mich.

Shouldice Brothers Sheet Metal Works
79 West Jackson St., Battle Creek, Michigan

Squires & Yates Sheet Metal
Box 259, 11 Mill St., Battle Creek, Michigan

FLINT AREA

A & D Metal Craft
2905 Davison Road, Flint, Michigan

All Temp Engineering
413 Asylum St., Flint, Michigan

Bab Roofing Co.
G-3319 S., Term, Flint, Michigan

Baughn Plumbing & Heating
1030 Ann Arbor, Flint, Michigan

Beaudry Heating
709 McFarlan, Flint, Michigan

Ben Agree Company
1549 East Atherton Road, Flint, Michigan

Dee Cramer, Inc.
1819 South Dort Highway, Flint, Michigan

E. E. Rodgers Roofing, Inc.
1915 Howard St., Flint, Michigan

Ferro Fab & Chemical Fab, Inc.
14337 N. Fenton Road, Flint, Michigan

George F. Earl Company, Inc.
G-1409 N. Genesee Road, Flint, Michigan

Karrer & Son
115 E. 14th St.—P. O. Box 635, Flint, Michigan

Marta Heating
2408 Lewis St., Flint, Michigan

National Roofing Co.
859 West Kearsley St., Flint, Michigan

Sterner Roofing & Sheet Metal Co.
201 Crapo St., Flint, Michigan

Storms Roofing & Sheet Metal, Inc.
3752 Robert T. Longway Blvd., Flint, Mich.

Wetzel Sheet Metal
1207 Corunna Ave., Owosso, Michigan

W. H. Mechem Co.
1848 Tower St., Flint, Michigan

Zack Company
201 Crapo St., Flint, Michigan

JACKSON AREA

Ajax Heating & Air Conditioning
531 20th St., Jackson, Michigan

Aire Flo Heating Company
203 East Biddle St., Jackson, Michigan

Colligan, Inc.
3900 Francis St., Jackson, Michigan

Daly Rutherford
116 Cooper St., Jackson, Michigan

Howard Heating & Ventilating
P. O. Box 713, Jackson, Michigan

McCleery Sheet Metal Works
1116 West Ganson St., Jackson, Michigan

Swager Heating
3020 Page Ave., Jackson, Michigan

Steinke-Fenton Sheet Metal
1355 Page Ave., Jackson, Michigan

KALAMAZOO AREA

Associated Mechanical Services, Inc.
2211 Miller Road, Kalamazoo, Michigan
3313 Saginaw Road, Midland, Michigan

Gear Sheet Metal, Inc.
728 Skinner Drive, Kalamazoo, Michigan

Industrial Sheet Metal Products
621 South Burdick St., Kalamazoo, Michigan

Kalamazoo Sheet Metal
172 East Water St., Kalamazoo, Michigan

Jesse C. Leonard Sheet Metal, Inc.
526 North Burdick St., Kalamazoo, Michigan

La Pine Sheet Metal
116 South Gremps, Paw Paw, Michigan

J. A. Temple Company
108 Parkway, Kalamazoo, Michigan

LANSING AREA

Dard, Inc.
1213 Center St., Lansing, Michigan

Michigan Sheet Metal Works
116 South Larch St., Lansing, Michigan

McConnell Sheet Metal, Inc.
943 Center St., Lansing, Michigan

Titus The Tinner
511 East Saginaw St., Lansing, Michigan

White Heating & Ventilating Co.
4107 West Saginaw St., Lansing, Michigan

SUMMARY OF SHEET METAL ITEMS

TO BE INCLUDED IN

SPECIFICATIONS FOR

ARCHITECTURAL SHEET METAL WORK

Compiled and Submitted

by

Sheet Metal and Air Conditioning

Contractors' National Association, Inc.

170 Division Street - Elgin, Illinois

Third Edition - 1958

DECLARATION OF PRINCIPLES

With the belief that the interests of the architect and the owner are best served by having the proper contractors install the work with which they are fully acquainted and best equipped to do, and over which the contractor and trade have been awarded jurisdiction, the SHEET METAL and AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION submits the following information to aid in preparing drawings and specifications.

We believe that the science of architectural sheet metal design and construction is of great importance and should provide permanent and lasting installations; requires a large amount of training, experience and practical knowledge; and we, therefore, consider it to be the obligation of every sheet metal contractor to know his business thoroughly and to use his skill to serve his customer.

FOREWORD

Generally, your sheet metal contractor fabricates and installs all sheet metal work of any metal 10 guage or lighter. Further, with the introduction of extruded metals, these extrusions should also be furnished and installed by the sheet metal contractor.

As it is impossible to give complete details or specifications for all the items of sheet metal work used in all types of construction, we also submit a list of publications which are available as a source of information for - weight or gauge of metals; types of metals, and detailed drawings showing approved and accepted construction.

The reference notes after some of the items listed refer to the "Specification Work Sheets" (SWS) published by the American Institute of Architects, revised May 20, 1951 and refer to pages and sections of the trade division covering the particular work in this edition. Items without reference notes are not included in the publication.

Kindly note that on some of the items listed we have suggested that you may wish to have a separate specification for these items. However, the installation will still remain within the jurisdiction of the sheet metal industry.

We recommend separate specifications be prepared for Ventilating and Air Conditioning as outlined in the "Code of Trade Practice for Ventilating and Air Conditioning" prepared by Sheet Metal and Air Conditioning Contractors National Association. Certain items in this Summary are marked (vs) and should be included in such specifications.

A copy of the "Code of Trade Practice for Ventilating and Air Conditioning" is available on request.

Should special installations arise where you need the advice of a competent authority, we suggest you seek the cooperation of your local sheet metal contractor who should be qualified to assist you.

EXTERIOR SHEET METAL WORK

Includes, but is not limited to, the following items of metal 10 ga. or lighter:
Buildings, Metal - (Unless specified separately)
Bins, Storage - (Unless specified separately)
Canopies, Metal - including all metal trim (Unless specified separately)
Copings, Extruded, Metal over wood (SWS, page 76, No. 26)
Cornerstone Boxes, Metal - (Unless specified separately)
Cornices, Metal - extruded, formed, metal lining over wood (SWS, page 75, No. 25)
Curtain Walls, Metal - (Unless specified separately)
Canvas Roof Decking
Downspouts, Exterior, including conductor heads, fasteners, ornamental bands, elbows, strainers, (SWS, page 75, No. 22, 24)
Expansion Joints, Metal - (SWS, page 76, No. 27)
Fascia, Roof Edgings - Metal - (SWS, page 73, No. 18)
Flashings, Metal - Base, cap, through-wall, spandrel, monitor sash, water table, cornice, termite shields - (SWS, Page 71, No. 13, 14; page 72, No. 15, 16)
Gutters, Metal - Roof drainage, floor drainage, condensation, etc. (SWS, page 73, No. 19; page 74, No. 20, 21)
Gravel Stops, Metal - in connection with built-up roofing (SWS, page 72, No. 17; page 73, No. 18)
Lagging, Metal - For pipes, boilers, tanks - (Unless specified separately)
Lead Linings - For floors, walls, etc.
Linings, Metal - For floors, counters, windows, radiator recesses, bread drawers, bins- (Unless specified separately)
Louvres, Metal - Metal over wood, extruded - (SWS, page 76, No. 29) (vs)
Letters, Metal - For identification - (Unless specified separately)
Marquees, Metal - Including all metal trim - (Unless specified separately)
Painting, Prime coat in shop or field
Panels, Wall, Porcelain - For store fronts below second story
Plastic domes, light admission - Including frames and bases (SWS, page 65, No. 2)
Ridges, Metal - For slate, composition, tile roofing - (SWS, page 69, No. 9-D)
Roofing, Metal - Flat seam, standing seam, batten seam, metal shingles, V-crimped roofing, corrugated iron, protected metal - (SWS, page 69, No. 10, 11)
Roof Decking, Steel - Welded or clipped to joists - (SWS, page 121, No. 2, 3; page 122, No. 4, 5, 6.)
Scuttles, Metal - For roofs, lining over wood
Scuppers, Metal - Overflow boxes
Skylights, Metal - Putty or puttyless, extruded, plastic domes (SWS, page 65, No. 2)
Snow Guards, Wire type or Rail type - (SWS, page 76, No. 28)
Signs, Metal - (Unless specified separately)
Slate Roofing - (SWS, page 68, No. 8, 9) (NOTE - although slate is sometimes applied by roofers or carpenters, the responsibility for installation should be with the sheet metal contractor)
Store Fronts, Metal, Metal and glass - Including trim - (Unless specified separately)
Siding, Metal - Locked seam, standing seam, batten seam, metal shingles, formed metal siding
Spires, Towers, Metal
Tile, Roofing - (SWS, page 68, No. 8, 9)
Ventilators, Spinner, Gravity, Power, Revolving - (vs)
Valleys, Metal - Open or closed type - (SWS, page 69, No. 9C, 11C)
Ventilators, Smoke or Stage
Windows, Hollow Metal, Extruded, All metals - (SWS, page 105, No. 4; page 112, No. 4; page 113, No. 5)

INTERIOR SHEET METAL WORK

Includes, but is not limited to, the following items of sheet metal 10 ga. or lighter;

Acoustical Linings - For interior of ducts (SMWIA-IAHFIAW Agreement)
Bins, Metal - (Unless specified separately)
Breechings, Boiler, Metal
Ceilings, Metal - With cornice and trim, including acoustical (SWS, page 189, No. 2; page 190, No. 3)
Cement Asbestos - For ducts, flues, housings - (vs)
Chutes, Metal - For packages, linen, etc. - (SWS, page 85, No. 25)
Collecting Systems - Fume, Waste Materials - including fans, motors, filters, grilles, etc. (vs) (Unless specified separately)
Dampers, Fire and Temperature - (vs)
Diffusers, All Types, For Air Conditioning - (vs)
Doors, Metal - Metal clad, tin clad labeled or unlabeled, jamb linings, Kalamein (SWS, page 89, No. 2; page 90, No. 3; page 91, No. 4; page 92, No. 6, 7, 8) Unless specified separately)
Duct Work Metal or substitute - mechanically connected, welded, flanged, riveted - (vs)
Dryers, Metal - Fabricated - (Unless specified separately)
Enclosures, Metal - For radiators, conditioning units, etc. - (Unless specified separately)
Fans, Ventilating - (vs)
Flexible Connections, Metal, etc. - (vs)
Filters, Heating and Conditioning Systems - (vs)
Guards, Machine - Belt - (vs)
Hoods, Metal - Kitchen range, fume, etc., including fans and filters (vs)
Isolation Bases, Ventilating apparatus (vs)
Lagging, Metal - For pipes, tanks, boilers -
Lockers, Metal - (Unless specified separately)
Linings, Metal - Radiator recesses, bins, drawers - tank - (Unless specified separately)
Ovens, Drying - (Unless specified separately)
Partitions, Office, etc. (SWS, page 99, 100, 101)
Partitions, Toilet - (SWS, page 97, No. 2, 3; page 98, No. 5, 6; page 100, No. 3; page 101, No. 5)
Process Piping - For breweries.
Shutters, Projection booth, complete with hardware - (Unless specified separately)
Shelving, Metal - (Unless specified separately)
Smoke Pipe, Metal and substitute - For breechings, gas vents, stacks, etc. (vs)
Spray Booths, Complete with ventilation - (Unless specified separately)
Tanks, Metal - (Unless specified separately)
Ventilating Systems - (vs)
Ventilators, Smoke or stage, Gravity, Power (vs)
Warm Air Heating Systems - complete including all equipment such as furnaces, fans, blowers, controls, filters, firing device, registers, grilles, duct work, (vs)
Washers, Heating and conditioning systems - (vs)

M A T E R I A L S

As a guide to the many materials used by the SHEET METAL CONTRACTOR for the items contained in this Summary, the following list is appended: --

Hot rolled steel sheets

Cold rolled steel sheets

Stretcher leveled steel sheets

Galvanized iron sheets

"Toncan" iron sheets - galvanized or black

"Armco" iron sheets - Armco zincgrip sheets

"Armco" iron sheets - Armco paintgrip sheets

Copper bearing sheets - galvanized or black

Terne plate sheets - (coated steel)

Tin plate

Copper sheets - cold rolled

Copper sheets - hot rolled (soft)

Copper sheets - lead coated

Stainless steel - All of the many alloys

Monel metal sheets

Lead sheets

Aluminum sheets

Asphalt or otherwise coated, copper and aluminum sheets

Asbestos coated steel sheets

Nickel sheets

Copper alloyed materials - Brass or bronze

Chinc metal (Zinc base sheet)

Zinc sheets

REFERENCE PUBLICATIONS AVAILABLE

INDUSTRY MANUALS

1. Standard Practice in Sheet Metal Work - Gutters, Conductors, Conductor Heads, Sheet Metal and Air Conditioning Contractors' National Association, 170 Division Street, Elgin, Illinois.

2. Sheet Copper - Copper and Brass Research Association 420 Lexington Ave., New York 17, N. Y.

3. Lead Industries Association, Graybar Building, 420 Lexington Ave., New York 17, N. Y.

4. Revere Standard Copper for Building Construction, Revere Copper and Brass Company, Inc., 230 Park Avenue, New York 17, N. Y.

5. Anaconda Sheet Metal for Building Construction, American Brass Co., Waterbury 20, Connecticut.

6. Modern Sheet Copper Practices. The American Brass Company, Waterbury 20, Connecticut.

7. Standard Practice in Sheet Metal Work - Skylights - Ventilators - Sheet Metal and Air Conditioning Contractors' National Association, 170 Division Street, Elgin, Illinois.

METAL ROOFING, GUTTERS, ETC.

1. Milcor Sheet Metal Products Catalog No. 306 - Inland Steel Products Co., P. O. Box 393, Milwaukee 1, Wisconsin.

2. Milcor Steel Roof Deck Catalog No. 240 - Inland Steel Products Co., P. O. Box 393, Milwaukee 1, Wisconsin.

3. Roofing Specifications and Data - Follansbee Steel Corp., Follansbee, W. Va.

4. Copper and Common Sense - Revere Copper and Brass Company, Inc., 230 Park Ave., New York 17, New York.

5. Master Specifications for Copper Roofing and Sheet Metal Work in Building Construction - Revere Copper and Brass Company, Inc., 230 Park Avenue, New York 17, N. Y.

6. Copper Roofing Products for Roofers and Architects - Chase Brass & Copper Co., Waterbury, Connecticut.

7. Follansbee Seamless Terne Roofing - Follansbee Steel Corporation, Follansbee, W. Va.

FLASHINGS

1. Standard Practice in Sheet Metal Work - Flashings - Sheet Metal and Air Conditioning Contractors' National Association, 170 Division St., Elgin, Ill.

2. Keystone Interlocking Thru-wall Flashing - Revere Copper & Brass Co., Inc. - 230 Park Avenue, New York 17, New York.

3. Anaconda Through Wall Flashings - American Brass Co., Waterbury 20, Conn.

4. Chase Thru-wall Copper Flashings - Chase Brass & Copper Co., Waterbury, Connecticut.

5. Chase Copper Expansion Joints - Chase Brass & Copper Co., Waterbury, Conn.

6. Chase One Piece Thru-wall Copper Flashing and Cap Flashing Receiver - Chase Brass & Copper Co., Waterbury Connecticut.

7. Chase Cop-O-Top - Chase Brass & Copper Co., Waterbury, Connecticut.

(Flashings, continued)

8. Simplex Reglet Systems - Revere Copper & Brass Co., Inc. 230 Park Ave., New York 17, N. Y.

9. Flashings by Cheney - Cheney Flashing Co., 623 Prospect St., Trenton 5, N. J.

10. Majestic Copper Flashings - C. G. Hussey & Co., Pittsburgh 19, Pa.

11. Rubberseal Copper - Mitchell Rand Mfg. Co., 51 Murray St., New York 7, N. Y.

12. Flashing Structural Clay Masonry - Structural Clay Products Institute, 1520 18th St., N. W., Washington 6, D. C.

VENTILATION

1. Industrial Ventilation - A Manual of Recommended Practice - American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation, P. O. Box 453, Lansing 2, Michigan.

2. American Society of Heating and Air Conditioning Engineers Guide, The Guide Committee, 51 Madison Ave., New York 10, N. Y.

ALUMINUM

1. Copings and Gravel Stops - Aluminum Company of America, Gulf Building, Pittsburgh, Pa.

2. Aluminum in Architecture - Aluminum Company of America, Gulf Building, Pittsburgh, Pa.

3. Aluminum Industrial Building Sheet - Aluminum Company of America, Gulf Building, Pittsburgh, Pa.

4. Window Sills and Thresholds - Aluminum Company of America, Gulf Building, Pittsburgh, Pa.

5. Roofing, Siding, Gutters, etc. - Reynolds Metals Co., Louisville, Ky.

6. Roofing, Siding, Gutters, etc. - Permanente Products Co., 1924 Broadway, Oakland 12, California.

STAINLESS STEEL

1. Stainless Steel Roof Drainage. Armco Steel Corp., 703 Curtis Street, Middletown, Ohio.

2. Architectural Uses of Stainless Steels. Armco Steel Corp. 703 Curtis Street, Middletown, Ohio.

3. Republic Sheets for the Building Industry. Republic Steel Corporation, Republic Building, Cleveland, Ohio.

4. Stainless Steel Curtain Walls. Allegheny Ludlum Steel Corp., Pittsburgh 22, Pennsylvania.

5. Stainless Fabricating Tips - Armco Steel Corp., 703 Curtis St., Middletown, Ohio.

LEAD

1. Modern Sheet Lead for Roofing and Flashing - Lead Industries Ass'n., 60 E. 42nd Street, New York 17, N. Y.

MONEL METAL

1. International Nickel Co., 67 Wall Street, New York 5, N. Y.

HEATING MANUALS

1. National Warm Air Heating & Air Conditioning Association, 640 Engineers Building, Cleveland 14, Ohio

ROOFING

1. Slate - Yorkmont Slate Co., Granville, N. Y.; O'Brien Bros. Slate Co., Granville, N. Y.; Rising & Nelson Slate Co., West Pawlet, Vt.; Buckingham-Virginia Slate Corp., 1103 E. Main St., Richmond 19, Va.

2. Tile - Ludowici Tile Co., 104 S. Michigan Ave., Chicago, Illinois

FOOTNOTE: As it is impossible to compile a complete list of all manuals relating to sheet metal work, we again refer you to your sheet metal contractor should you be unable to secure information you require from the above list.

GUTTERS, CONDUCTORS
CONDUCTOR HEADS

**SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.**

170 DIVISION STREET • ELGIN, ILLINOIS

A National Organization to Improve, Extend and Protect the Uses of Sheet Metal in Ventilating and Air Conditioning, Warm Air Heating, Industrial Air Handling, Architectural Sheet Metal, Roofing.

SHEET METAL AND AIR CONDITIONING CONTRACTORS'
NATIONAL ASSOCIATION, INC.

170 DIVISION STREET • ELGIN, ILLINOIS

FOREWORD

In 1929, the National Association of Sheet Metal Contractors (dissolved in 1933) published "Standard Practice in Sheet Metal Work," a 750 page reference book of standards of practice in fabricating and erecting sheet metal work.

Several years of exhaustive research and study, by scores of men comprising the sub-committee which prepared Sections covering particular phases of sheet metal construction, preceded the actual publication.

Much of the construction shown in Standard Practice in Sheet Metal Work was, at the time of its publication, original material — not to be found in other published literature of the industry. Many of the constructions shown had their origin in the very old craftsmanship brought to this country by the sheet metal artisans who came to America in the last century.

To this basic heritage was added the new materials and new techniques of the first quarter of the twentieth century.

The men who prepared Standard Practice in Sheet Metal Work created even beyond their vision. While the industry has advanced notably in the years since publication of this book, basically most of the constructions shown in Standard Practice in Sheet Metal Work are, today, as applicable as they were in 1929.

Standard Practice in Sheet Metal Work was widely distributed among the architects of the 1930's. But in the 1930's, through a series of circumstances, plates, unbound pages, drawings, manuscripts passed out of existence.

Today, despite the greatly enlarged literature of the industry, there is a growing demand for copies of Standard Practice in Sheet Metal Work. To meet this demand, the Architectural Sheet Metal Standards Committee of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., has undertaken the publication of a series of Manuals to replace the former book. Each Manual will deal with one of the major phases of present day sheet metal construction.

These Manuals make use of a large part of the text and drawings from Standard Practice in Sheet Metal Work. Where necessary, original text and drawings will be supplemented by information which accommodates the new materials and new techniques which have become acceptable since 1929.

The Sheet Metal and Air Conditioning Contractors' National Association has been given permission to use material from Standard Practice in Sheet Metal Work by the heirs of the estate of George Harms, the General Chairman of the Trade Development Committee of the former association. This permission is sincerely appreciated.

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
Architectural Sheet Metal Standards Committee

ACKNOWLEDGMENT

This Manual of construction for sheet metal work is made possible only because of the foresight and immeasurable labors of the members and section chairmen of the Trade Development Committee of the former National Association of Sheet Metal Contractors and the guiding spirit of these farsighted committeemen—the General Chairman—George Harms of Peoria, Illinois.

Through his untiring efforts, Standard Practice in Sheet Metal Work developed from a dream of the industry into a reference guide of proper construction for sheet metal contractors and the architects and engineers who design and specify sheet metal work.

Through his willingness to contribute financially, far beyond his just share, Standard Practice in Sheet Metal Work was printed and is recognized as one of the monumental books of the construction industry.

So that these services which George Harms gave so generously to this industry may be for all time perpetuated in the minds of his fellow sheet metal contractors and those who buy our services, the Sheet Metal and Air Conditioning Contractors' National Association, Inc., hereby dedicates this Manual to the memory of the man who wrought so well to establish the sheet metal industry on a high plane —

GEORGE HARMS
1860—1945

CONTENTS

Introduction

Roofing, Gutters, Conductors

Section I

The roof is the most important part of a building as it protects from the elements, not only all other parts of the structure, but the contents and occupants as well.

Frequently the owner has but a hazy idea of the merits of the various types of roofing and he depends on the architect to recommend the best material available for the purpose.

The practice of trying to effect a saving by reducing roofing costs, when the total estimates submitted for a building exceed the amount appropriated, or available, has been proven wasteful and expensive in the end. The architect or general contractor who persists in this practice is not serving the best interests of his clients.

In some types of buildings the roof is an important part of the architectural design and it is not difficult to decide what type of roofing is best suited for the construction.

Whether tin, slate or tile is selected for the roof of a residence, school or public building, careful consideration should be given to the quality of the material and the selection should be made of a material which has proven itself for durability as well as for its adaptability to the particular type of architecture.

It is equally important to give careful consideration to the selection of roofing material for factories, warehouses and other similar buildings as in many cases expensive machinery and equipment, as well as valuable merchandise, must be protected against damage.

The methods illustrated and described in this section should be followed to obtain the type of roof which will give many years of satisfactory service at the lowest cost per year of such service.

Roofing, Gutters, Conductors

Section I

Molded Sheet Metal Conductor Heads

Drawing No. 1

The elevations of nine types of sheet metal conductor heads for square, round or rectangular conductors, are presented in Drawing No. 1. The method of erecting them in practical work is shown on the following drawings.

There is no limit to the designs that may be used in conductor head construction. While those shown have right angular corners in plan, heads may be constructed in round, octagon and beveled outlines, when viewed in plan.

Plain types are shown in Fig. 1 to 3, inclusive, while more elaborate designs are indicated in Fig. 4 to 9, inclusive.

In making use of conductor heads two methods are employed. In one case the gutter outlet discharges into the head and the conductor is connected to the bottom of the head; in the other case the gutter outlet is connected directly to the conductor and a false head is used for ornamental purposes only.

In all cases where water is discharged into conductor heads, screens are used to cover the top to prevent birds building nests in the heads; when false heads are used, sheet metal covers are employed.

Conductor Fasteners and Ornamental Bands

Drawing No. 2

Drawing No. 2 shows the details for conductor fasteners and ornamental sheet metal bands for either round or square conductors or leaders.

In the upper plan in Fig. 1 is shown the construction of a wrought metal conductor fastener made from 1/8 x 1 in. material. An elevation of the ornamental bands is shown, there being no limit to the designs in which they may be produced in sheet metal. The plan of the ornamental bands is presented below. Fig. 2 shows the plan and elevation of a fastener and ornamental band for a round conductor, and Fig. 3 presents a plan and elevation of fastener and ornamental band for a square conductor. In this construction, a malleable iron hook or fastener is used, the conductor being secured with twisted wire, as shown: This style of fasteners can also be obtained for round conductor. If desired to omit the ornamental band, fasteners may be hinged in either round or square shapes.

Roof Connections to Conductor Heads

Drawing No. 3

Two types of roof connections are given in are employed.

Fig. 1 shows a flat roof connected to an outlet tube, which in turn is connected to a conductor head, the head connected to the conductor or leader. This leader is secured to the wall with a conductor fastener over which the ornamental sheet metal band is placed. Note that the outlet tube is protected from leaves and rubbish entering the tube by a hinged strainer.

In Fig. 2 is presented another type of connection from a hanging gutter on a pitched slate roof to a gooseneck which is connected to the conductor head. The conductor head is connected to the conductor as shown.

Another method may be employed whereby the gooseneck is connected to the conductor with a false head serving as an ornament only.

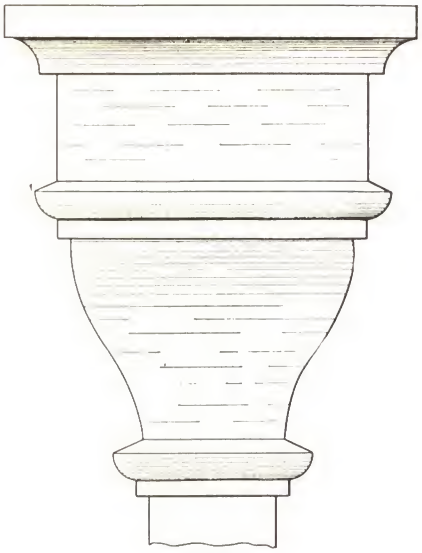


FIG. 1

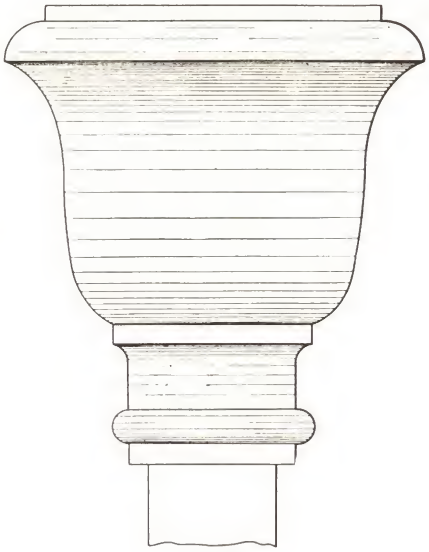


FIG. 2

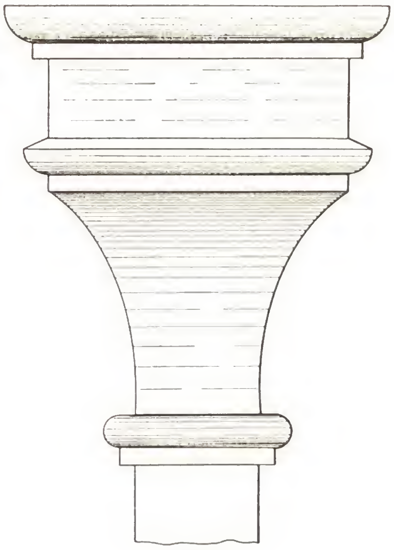


FIG. 3

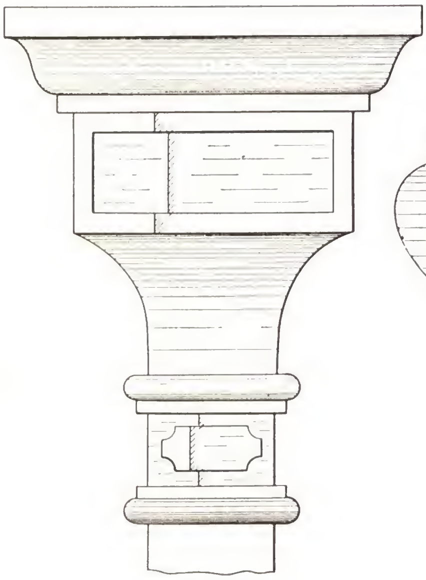


FIG. 4

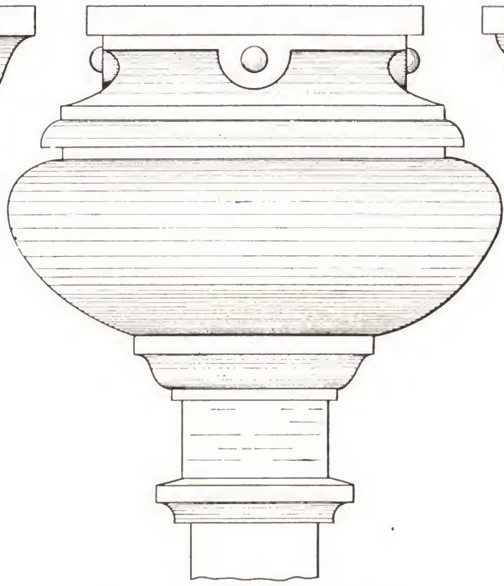


FIG. 5

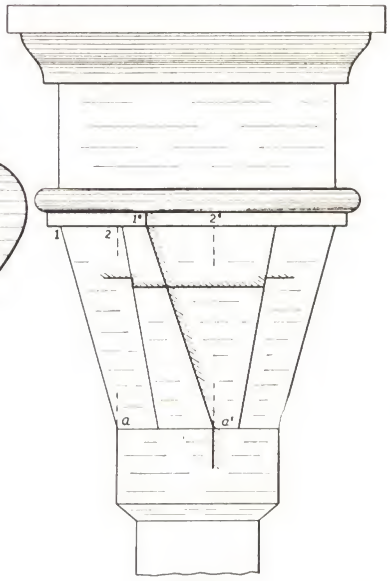


FIG. 6

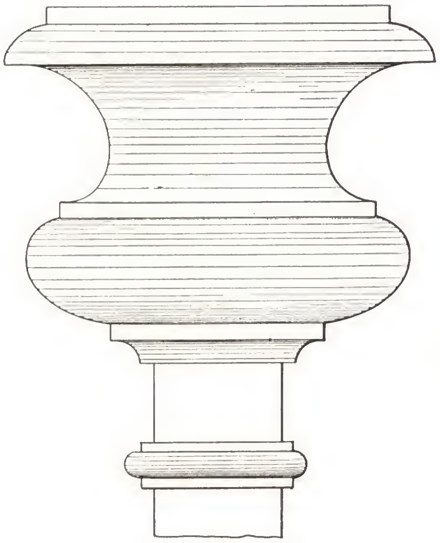


FIG. 7

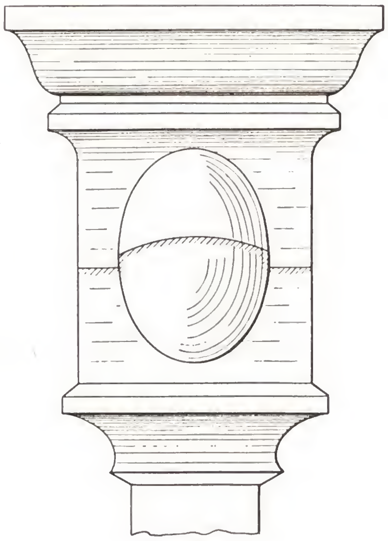


FIG. 8

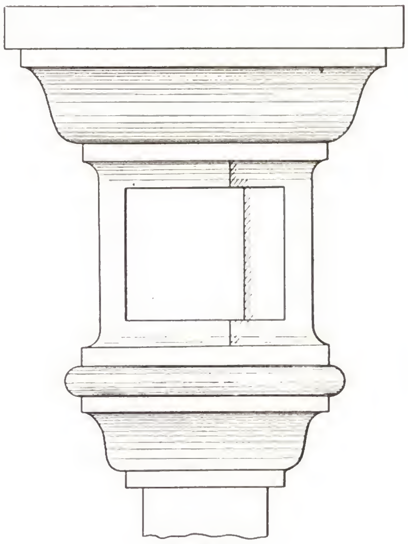


FIG. 9

—SCALE 2" = 1'-0"—

DRAWING NUMBER 1

MOLDED SHEET METAL CONDUCTOR HEADS

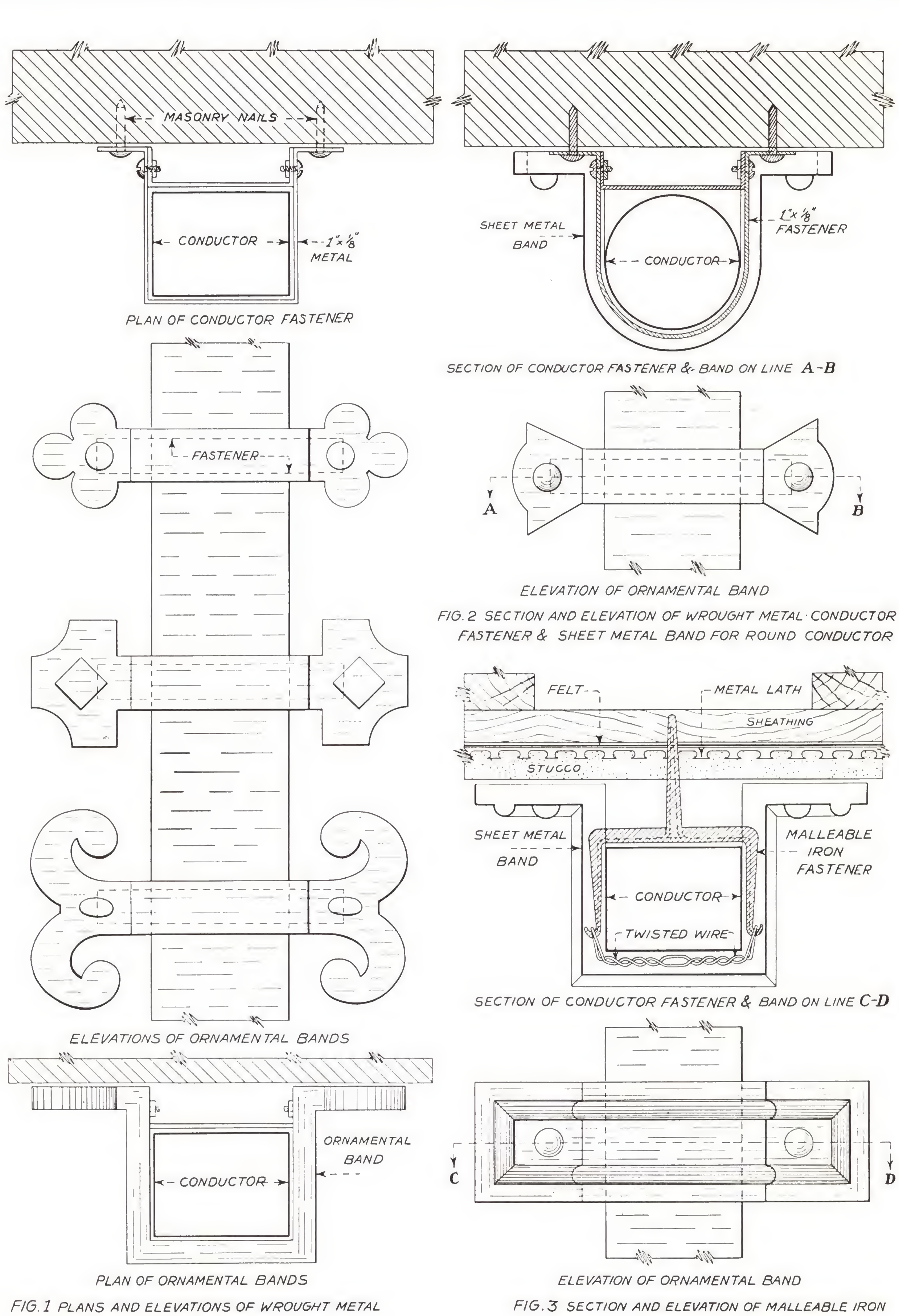


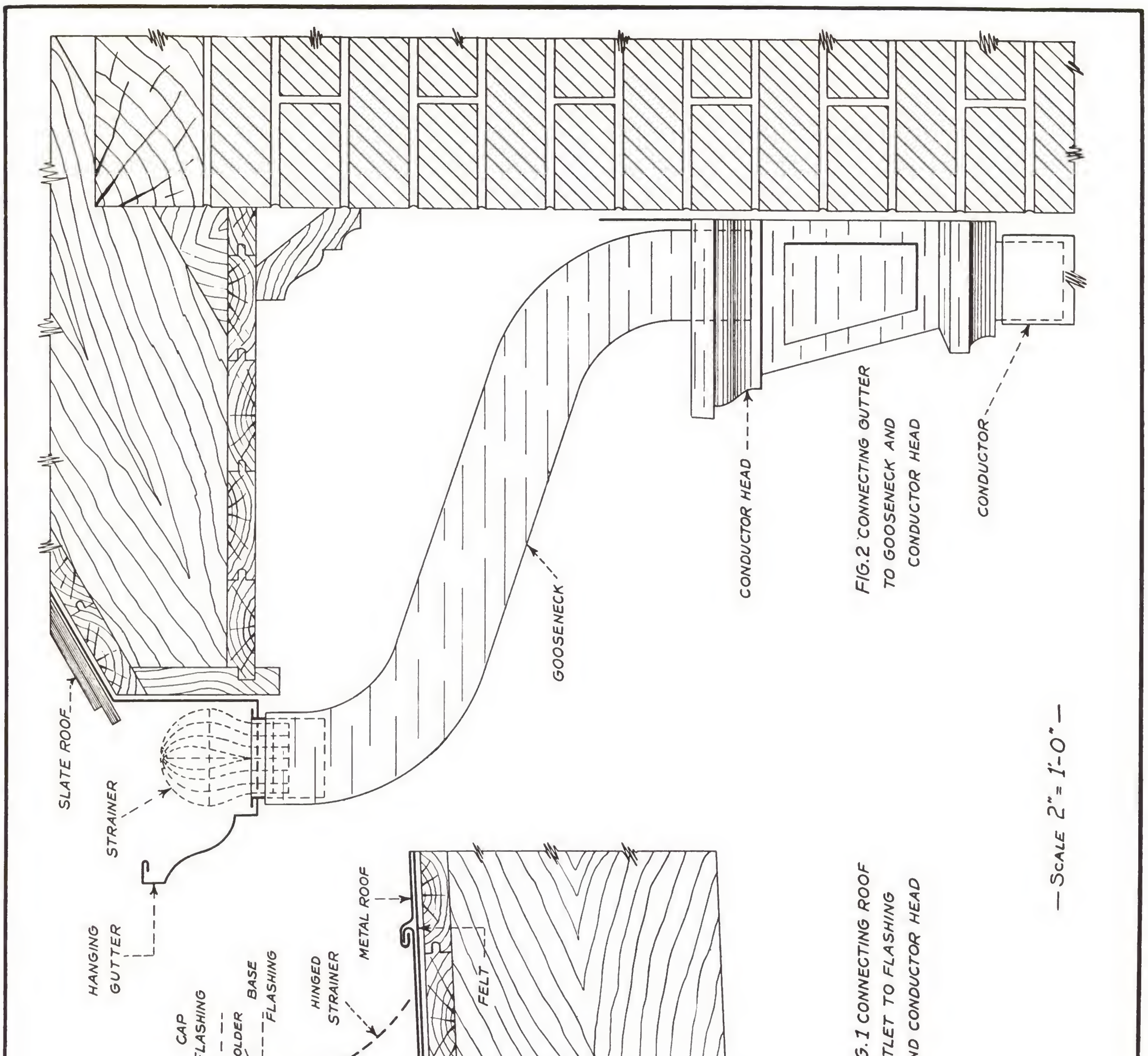
FIG. 2 SECTION AND ELEVATION OF WROUGHT METAL CONDUCTOR FASTENER & SHEET METAL BAND FOR ROUND CONDUCTOR

FIG. 1 PLANS AND ELEVATIONS OF WROUGHT METAL CONDUCTOR FASTENER & SHEET METAL BANDS FOR SQUARE CONDUCTORS

FIG. 3 SECTION AND ELEVATION OF MALLEABLE IRON CONDUCTOR FASTENER & SHEET METAL BAND FOR SQUARE CONDUCTOR

— SCALE 3"=1'-0" —

DRAWING NUMBER 2 CONDUCTOR FASTENERS AND ORNAMENTAL BANDS



DRAWING NUMBER 3 ROOF CONNECTIONS TO CONDUCTOR HEADS

Overflow, Outlet Tube and Conductor Head

Drawing No. 4

When a gutter is formed between a parapet wall and a pitched roof, as shown in the detail in Drawing No. 4, provision is made for overflow tubes at intervals along the wall to prevent the water from backing over the flashing of the gutter lining, in case of stoppage or freezing of conductor.

Note in the drawing that the gutter flashing and the lock to which the standing seam roofing is connected is not less than 3 in. above the upper line of the overflow tube. The overflow projects about 2 in. over the outside wall with a downward flange which acts as a drip.

To prevent seepage of water through the wall in case of an overflow, the overflow tube is flashed all around on the outside as indicated. The outlet tube is connected to the gutter lining in the usual manner with a hinged strainer as shown. The conductor band and conductor are shown with a 1-in. projection from the wall. Conductor fasteners of the type shown in Drawing No. 2 are used.

Outlet Tube and Overflow Connection Through Gargoyle

Drawing No. 5

The method of making roof connections when the outlet and overflow tubes are combined in one in the form of a Y and pass through a sheet metal gargoyle is presented in Drawing No. 5. The connection to the metal flashing and conductor head is also shown.

As the height of the parapet wall above the roof line is not over 18 in., the base flashing is put on in one piece, locked to the projecting edge which is caulked in the top of the stone coping, as shown. This lock provides for expansion and contraction, particularly when copper is used. The one-third full size detail of this lock is shown in Fig. 2.

Attention is directed to the construction of the outlet tube and overflow in Fig. 1. A water-stop is placed where indicated on the drawing, so that in case of heavy rain, the water rushing through the outlet tube will not overflow through the overflow tube while the conductor is open. If, however, the conductor is frozen shut in the winter, when the ice begins to thaw on the roof, the water then overflows through the mouth of the gargoyle.

Conductor, Head and Bands—Typical Erection

Drawing No. 6

The sectional view and partial elevation in Drawing No. 6 show a conductor erection from the eaves gutter to the sewer drain.

The roof in this case is covered with standing seam roofing connected to a half-round gutter. By means of a gooseneck the gutter is connected to the conductor head, which leads into a square conductor, secured with conductor hangers 1 in. away from the wall and covered with ornamental sheet metal bands.

Where the conductor may be subject to abuse, it is recommended that cast iron sewer connections or cast iron shoes be used as indicated, whether connecting to the sewer drain or leading to the ground.

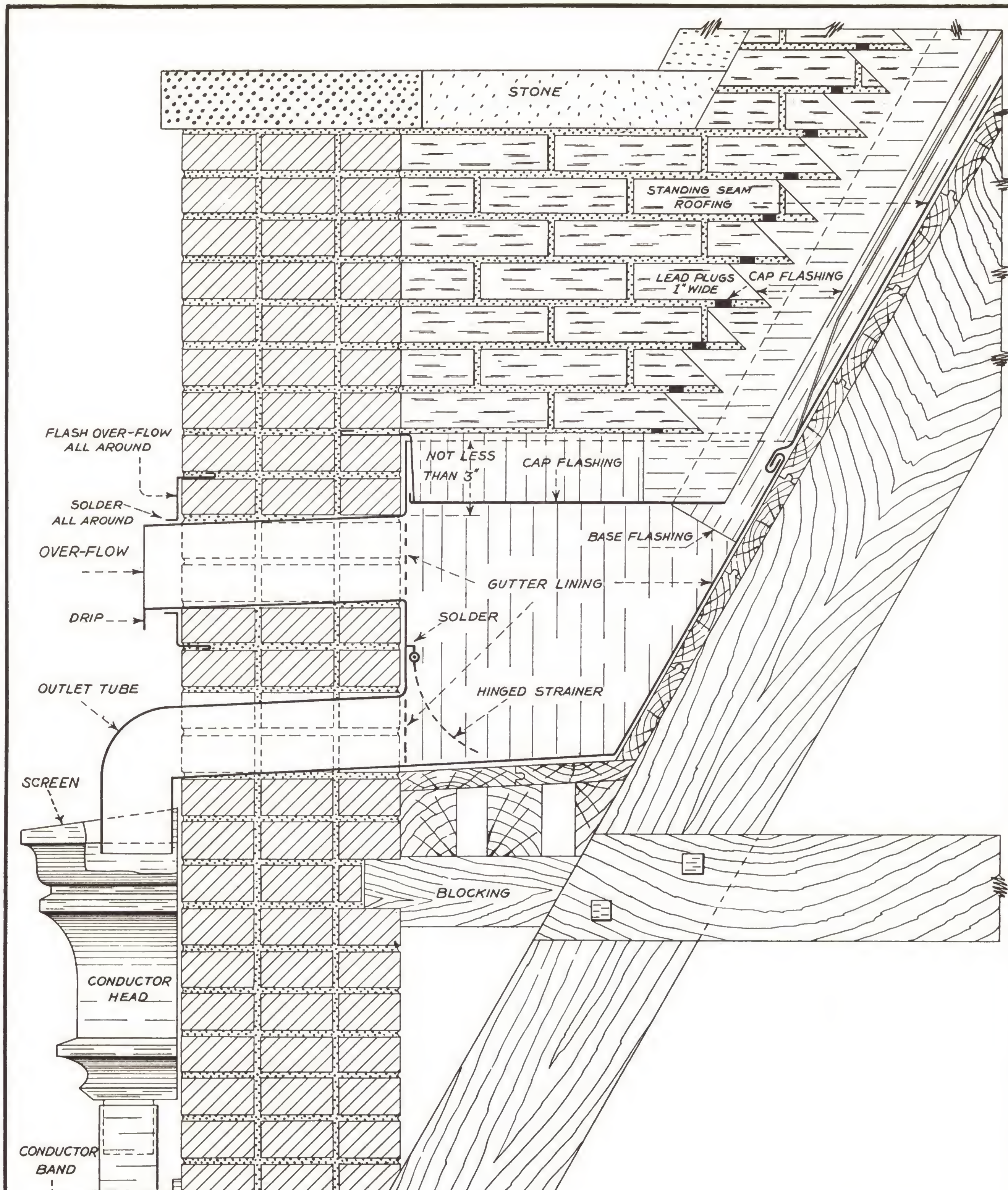
A sloping screen top is to be used on the conductor head.

Fourteen Styles of Roof Gutters and Eaves Trough

Drawing No. 7

In Drawing No. 7 fourteen different types of roof gutters and eaves troughs are shown.

The styles marked *A*, *A-A* and *B* are for use on pitched roofs and are sometimes called stop gutters. Several courses of shingles, slate or tile are applied before these gutters with the proper pitch to outlets, are installed. Braces are fastened to the gutter bead and nailed to the sheathing and spaced 30 in. on centers. The roofing is then applied in the usual manner.

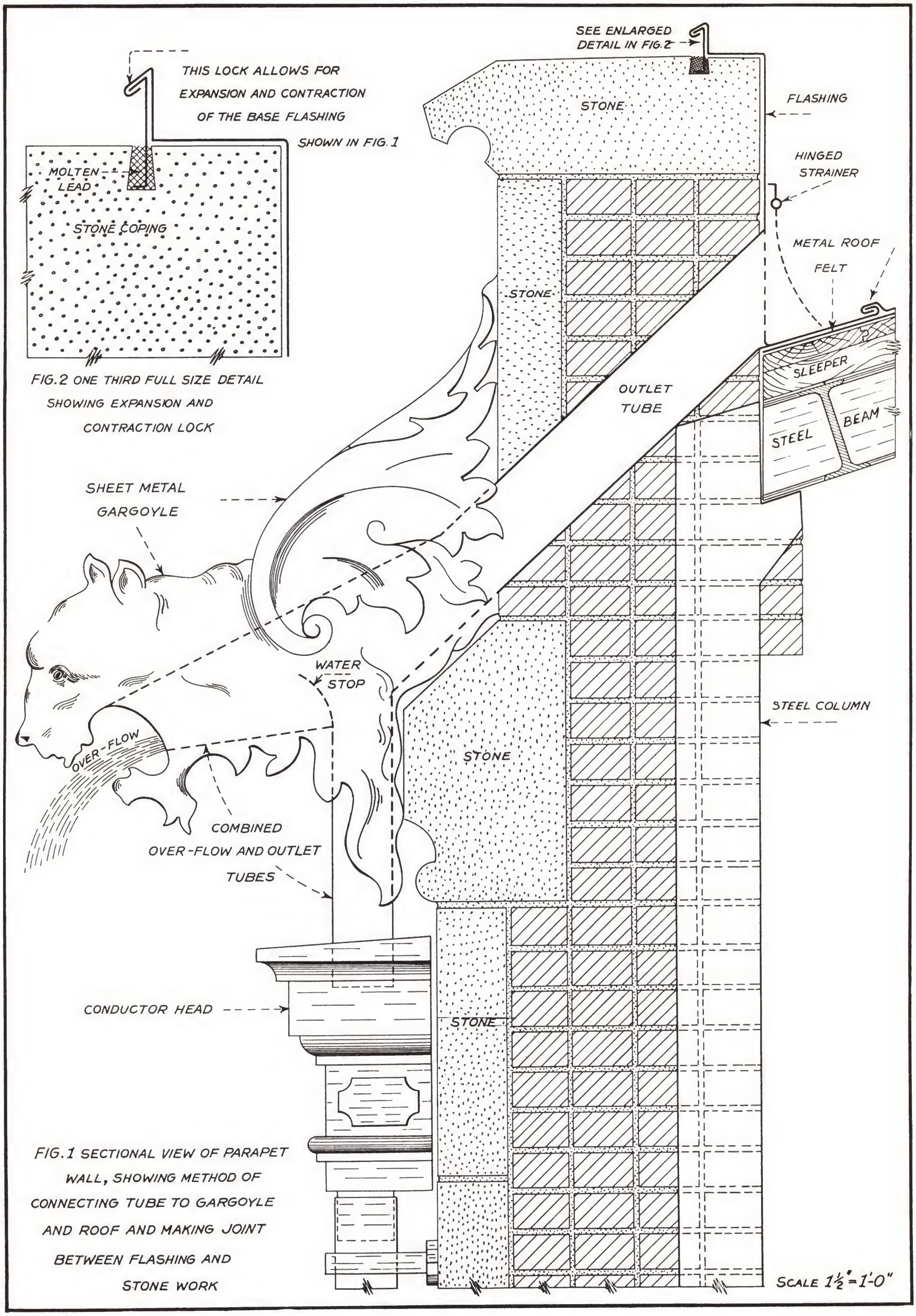


SECTIONAL VIEW OF GUTTER BETWEEN PARAPET WALL AND PITCHED ROOF SHOWING FLASHINGS AND POSITION OF OVER-FLOW TUBE ALSO METHOD OF CONNECTING OUTLET TUBE TO GUTTER LINING AND CONDUCTOR HEAD

— SCALE $1\frac{1}{2}'' = 1'\text{-}0''$ —

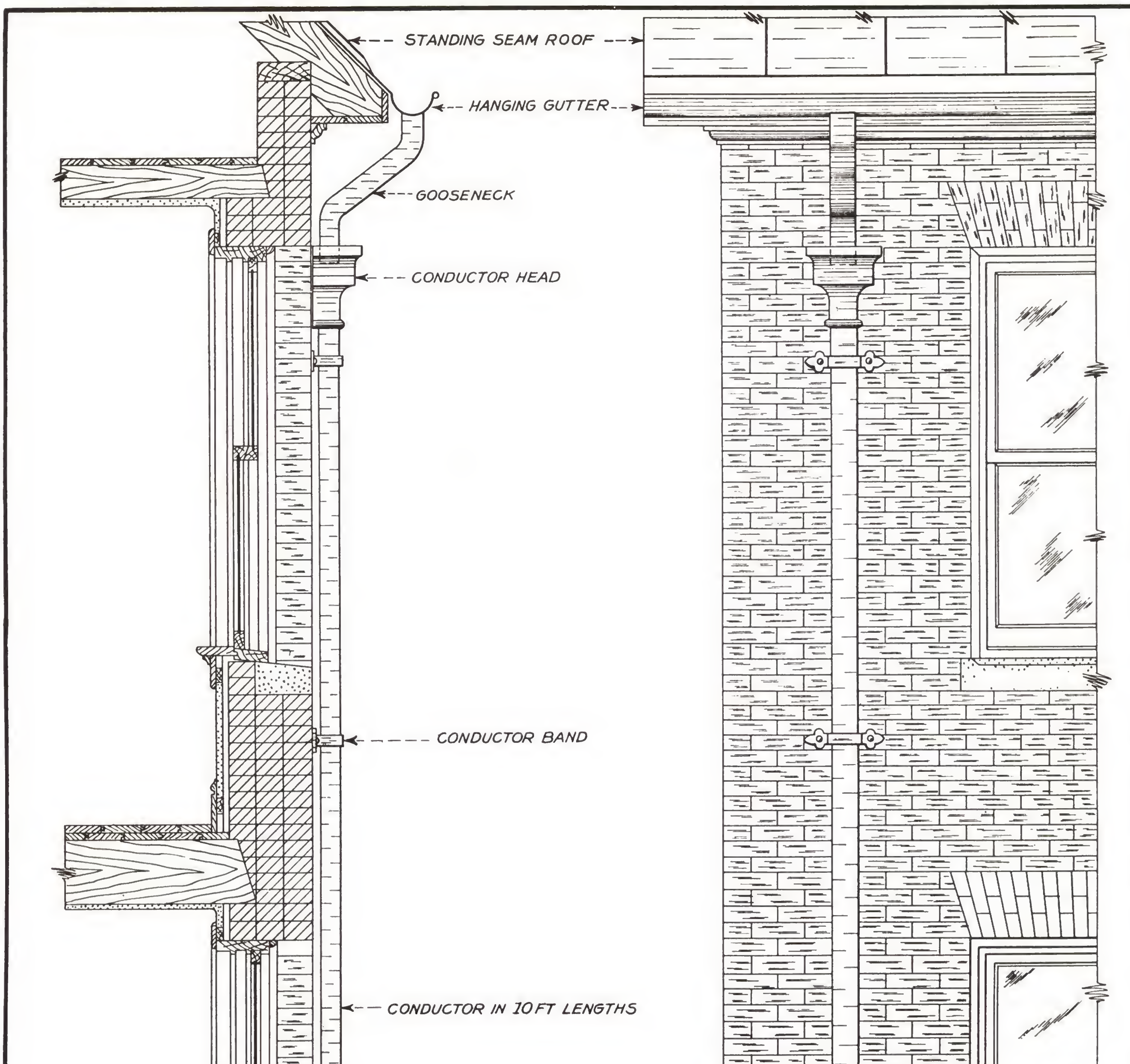
DRAWING NUMBER 4

OVERFLOW, OUTLET TUBE AND CONDUCTOR HEAD



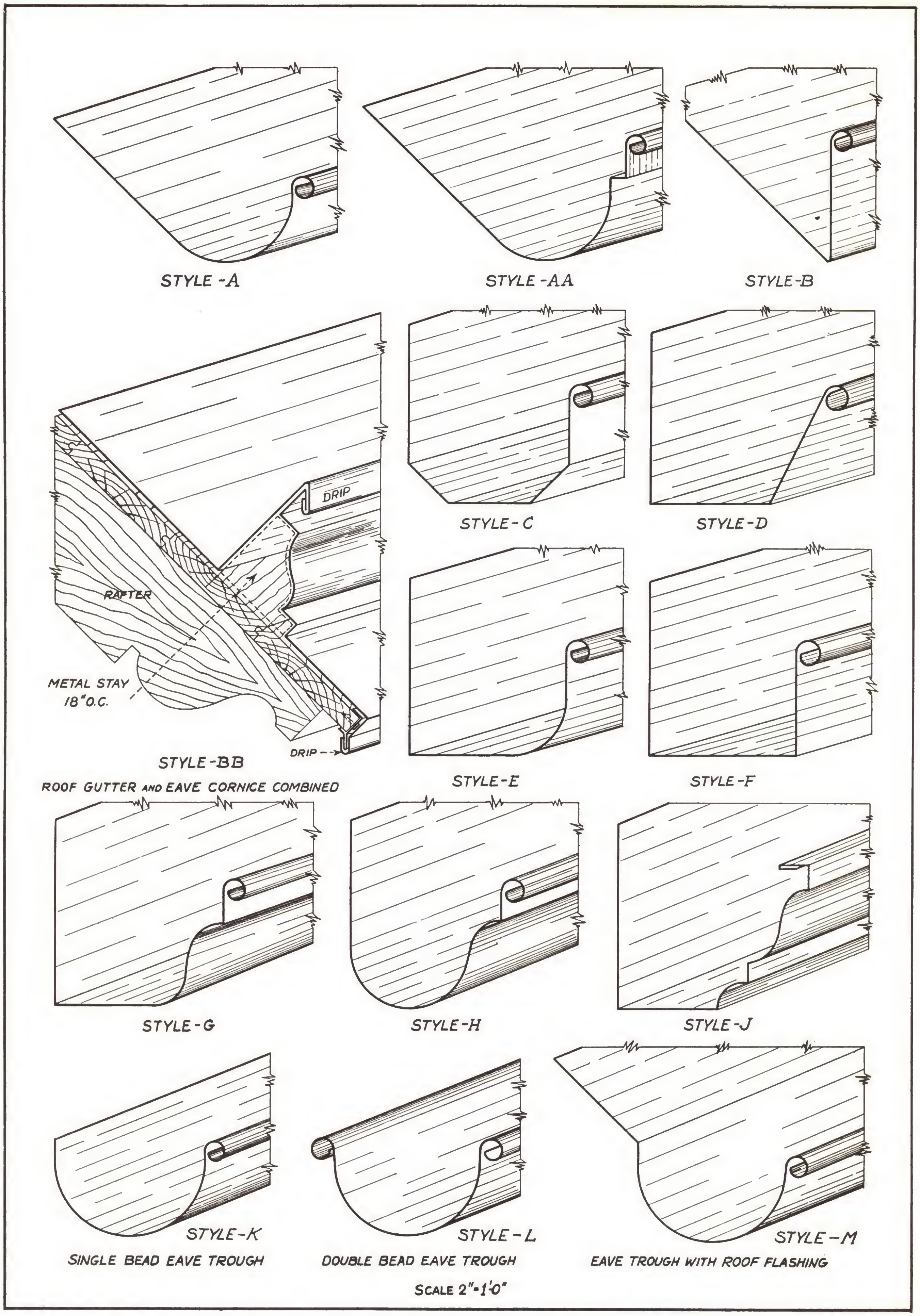
Drawing Number 5

OUTLET TUBE AND OVERFLOW CONNECTION THROUGH GARGOYLE



DRAWING NUMBER 6

CONDUCTOR, HEAD AND BANDS - TYPICAL ERECTION



DRAWING NUMBER 7 ROOF GUTTERS AND EAVES TROUGH

A combination roof gutter and eaves cornice is shown in that marked *B-B*. With this type the eaves strip is first applied to the edge of sheathing, the cornice locked to this as shown, the metal or wood stays spaced 18 in. on centers. The edge of the gutter is turned at the front and hooked and locked to the edge of the cornice. Provision for the proper pitch to the outlet is important.

Styles *C* to *K* are standard types of hanging gutter. With these $1/8$ x 1-in. band iron hangers are used, formed to the shape of the gutter, spaced 30 in. on centers and nailed to the facia of the cornice with proper pitch to outlets. Band iron braces are attached and applied to the roof in the same manner as for *A* and *B*.

Style *L* has a double bead and is hung below the eaves with special hangers. Style *M* has an apron extending up the roof and can be shingled over or the upper edge locked to the sheet metal roof. Roof braces are the same as for Styles *A* and *B*.

Roof Gutters for Slate or Flat Tile Roofs

Drawing No. 8

In Drawing No. 8 two types of roof gutters for slate or flat tile roofs are presented.

The general construction of the type marked Fig. 1 is the same as for the standard roof gutter shown in Drawing No. 7. This gutter is designed for heavy duty where large gutters are required and also to withstand the weight of snow and ice. The slotted hole in the angle iron allows for expansion and contraction of the metal. On this gutter the edge is turned at the top and cleated to the roof. Provision for proper pitch to the outlets is made.

Fig. 2 is a roof gutter and cornice combined. The wood construction is as shown on the drawing, the board for the bottom of the gutter having the proper pitch to outlet. The front or cornice is applied as shown or an eaves strip as shown on Drawing No. 7, Style *B-B* may be used. The gutter is formed the same shape as the woodwork; the front edge at *C* is single or double seamed. A cant strip is placed on the roof and the gutter constructed over it. The gutter is then nailed to the roof sheathing above the cant strip. Felt used under slate or tile roofing laps over the sheet metal gutter in all cases.

Roof Gutter for Concrete Tile Roof

Drawing No. 9

The method of connecting a roof gutter to concrete tile roof and also the correct method of connections between the gutter and conductor, are presented in Drawing No. 9.

As shown in Fig. 1, the gutter is formed with a bead or with angle iron as shown in Fig. 1, Drawing No. 8. In place of top braces and nails through the tile, $1\frac{1}{2}$ x $\frac{1}{4}$ band iron braces are used under the gutter, formed to the proper shape. These are laid over the second course of tile, 30 in. on centers, and secured to wood sleeper, as shown.

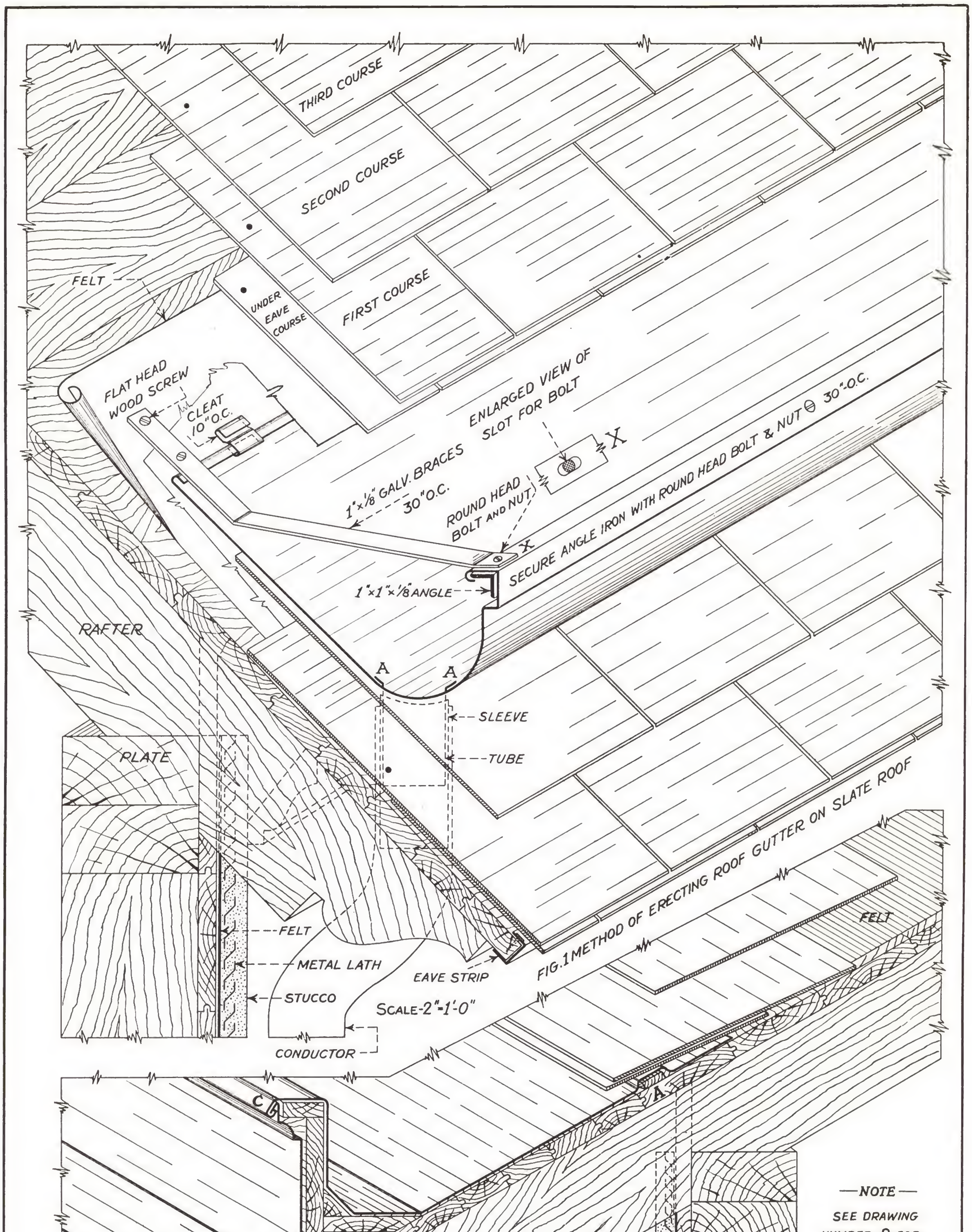
Braces are carefully lined to give the proper pitch of the gutter to the outlet. The gutter is laid on the braces, the top having a $\frac{1}{2}$-in. edge turned is secured to the wood sleeper by continuous cleat. No nails are driven through the gutter, thus providing for expansion and contraction. All cross seams are riveted and soldered.

A band iron cleat is formed to match the bead of the gutter and is riveted or bolted through the gutter at each brace.

The flange and sleeve are shown in Fig. 2 and 3. The size of the flange is four times the diameter of the sleeve. The sleeve fits into the flange, cut to the pitch of the roof and properly lapped and soldered. The length of the sleeve is shown at X, the sleeve inserted in the conductor not less than 2 in. The flange is laid on the second course of tile under the gutter as shown at *A*. The tube slips into the sleeve not less than 2 in.

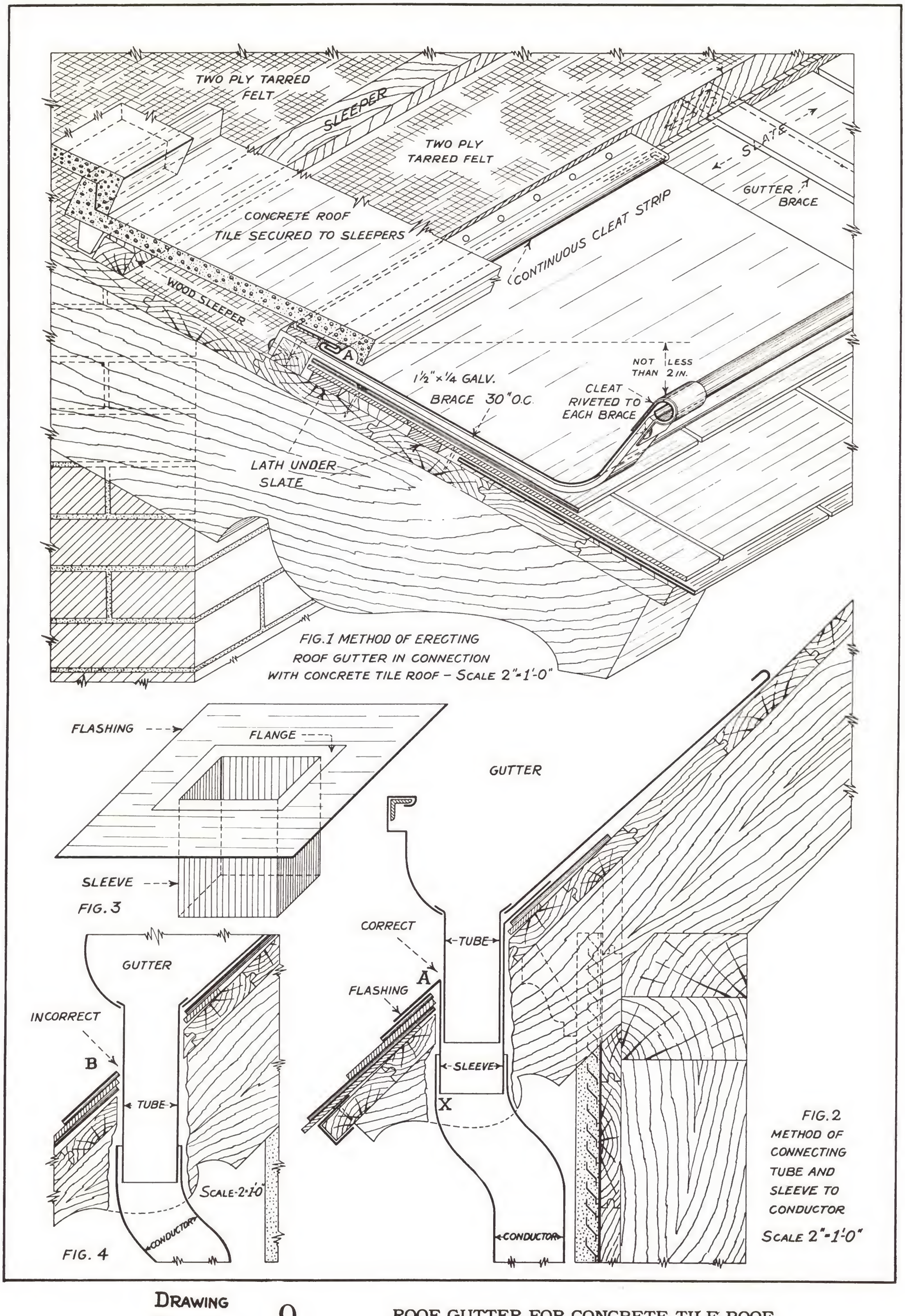
The construction of the flange and sleeve in this manner prevents streaking the walls and conductors should the tube become disconnected.

Fig. 4 shows the incorrect procedure, but is one frequently employed.



DRAWING NUMBER 8

ROOF GUTTERS FOR SLATE OR FLAT TILE ROOFS



DRAWING NUMBER 9 ROOF GUTTER FOR CONCRETE TILE ROOF

Gutters for Tile Roof—Concrete Construction

Drawing No. 10

Drawing No. 10 shows another type of roof gutter laid in concrete construction in connection with Spanish tile roofing and sheet metal cornice. The method of lining roof gutters in fireproof, concrete construction and at the same time allowing for expansion and contraction of the metal, is given below.

While the roof is being filled with cinder concrete, beveled sleepers are laid parallel to the slope of the roof, about 24 in. apart, in the shape similar to Diagram *S* at left of Fig. 1. The gutter shown is graded to the roof outlets with concrete or wood blocking.

As the gutter is large in girth, allowance is made for free movement of the metal by the use of a cap flashing at the eaves. Care is required when bending the upper part of the cap flashing as at *P*, to have it pitch to the front.

When sheathing the gutter, the upper edge of the front of the gutter must be at least 2 in. below the bottom of the cap flashing to prevent leakage.

Over the top closure tile a cap flashing is set, first bending the top in position as shown at the right at *A*. The upper edge is secured by cleats spaced 10 in. apart. To this projecting edge, the gutter lining is locked as at *B*, then turned down with the mallet, loosely, as at *C*. Cleats, indicated by *X*, are nailed 10 in. apart and over the cleats the cap flashing is laid and the projecting ½-in. edge of the cleat turned over as shown at *Y*, to hold down the flange.

The outlets are connected to the inside cast iron drain pipes, by means of heavy sheet lead tubes. Brass ferrules are soldered to the lead tubes and caulked into the cast iron drain by the plumber.

When the run of the gutter is long, expansion joints are placed at the high points of the gutter, following the constructions shown in Fig. 2 to 4, inclusive. Fig. 2 shows how the heads are flanged and soldered to the ends of the gutter. The left head is indicated by 1, 2, 3, 4 and 5, and the right head by 1′, 2′, 3′, 4′ and 5′. These two heads have flanges turned outward, as shown. They are high enough above 5 and 5′ to permit the sliding cap to slip in place easily. As the head extends below the bottom line of the cap flashing and as the sliding cap slips up behind the cap flashing, as shown, allowance is made for a flange which acts as a lock, above the bends at *a* and *a*. This short flange is soldered to the back of the gutter lining from *a* to *b* on both ends. The sliding cap is made as shown in Fig. 3 and 4.

Fig. 3 shows the upper end of the sliding cap. Note that it slips over the flanges bent on the heads and also locks in the lock edges *a-b* shown in Fig. 2, as indicated in Fig. 3. When bending the lock on the sliding cap, a piece of band iron about ⅛ in. thick is placed in each lock at *d-e* and then *d-e* is bent to the proper angle. This prevents the lock from closing. The band iron should be oiled before insertion to facilitate its easy removal.

The method of construction at the bottom of the sliding cap is shown in Fig. 4, where the lower end is shown broken. Note that the turned edges of the cap lock in the projecting flanges of the heads and a vertical flange *i* turns down to cover the cap flashing at *C* in Fig. 1.

After the heads are soldered in position, the gutter is set, the distance *O* between the heads in Fig. 2 being determined by the temperature at the time of erection and the length of gutter for which expansion must be allowed.

Eaves Gutters at Flat Roofs

Drawing No. 11

In Drawing No. 11 four different types of eaves gutters connecting to flat seam and composition roofs, are presented.

A typical eaves gutter with reinforced bead for flat seam roofing is shown in Fig. 1, the bottom of the gutter resting on projecting brick corbels. An angle edged drip strip is soldered to the bottom of the gutter to prevent seepage of water through the brick wall in case of an overflow. The edge is turned at top of the gutter and cleated to the sheathing.

The roofing material is locked in the usual manner. Band iron braces are bolted to the top edge of the gutter and secured to the roof with two barbed wire nails. The braces are capped with sheet metal and soldered to prevent leakage. To avoid water following the brace and dripping over the front edge of the gutter, braces are twisted as shown, and spaced 30 in. on centers.

The front edge of the gutter is lower than the eaves line of the roof to avoid water backing up on the roof. When the gutter connects to an inside drain, the tube is carried through the full thickness of the wall with a brass ferrule for

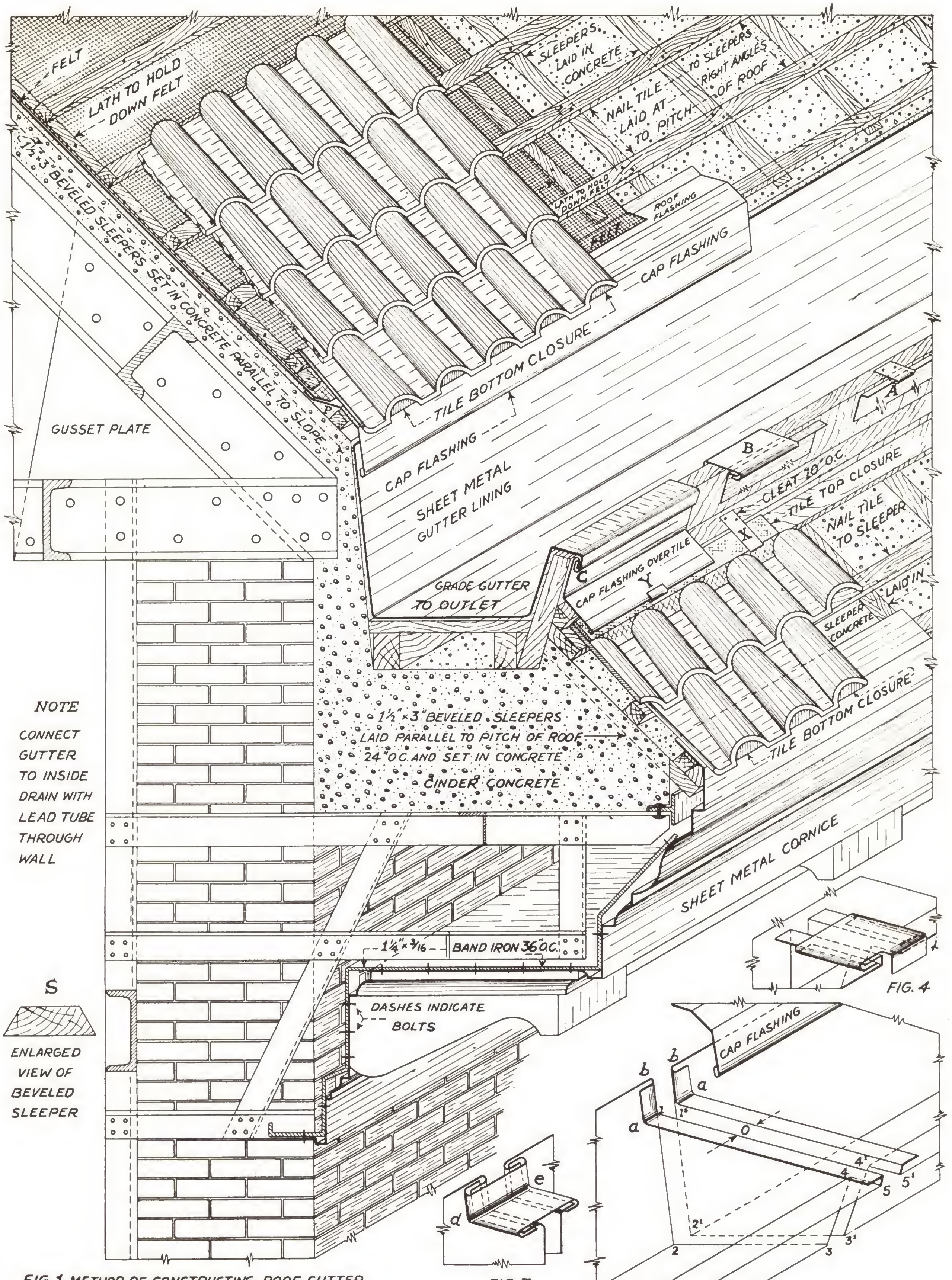


FIG. 1 METHOD OF CONSTRUCTING ROOF GUTTER ON A CONCRETE BASE IN CONNECTION WITH A SPANISH TILE ROOF AND SHEET METAL CORNICE

FIG. 2 CONSTRUCTION OF EXPANSION JOINT

SCALE ¾" = 1'-0"

DRAWING NUMBER 10

GUTTERS FOR TILE ROOF -- CONCRETE CONSTRUCTION

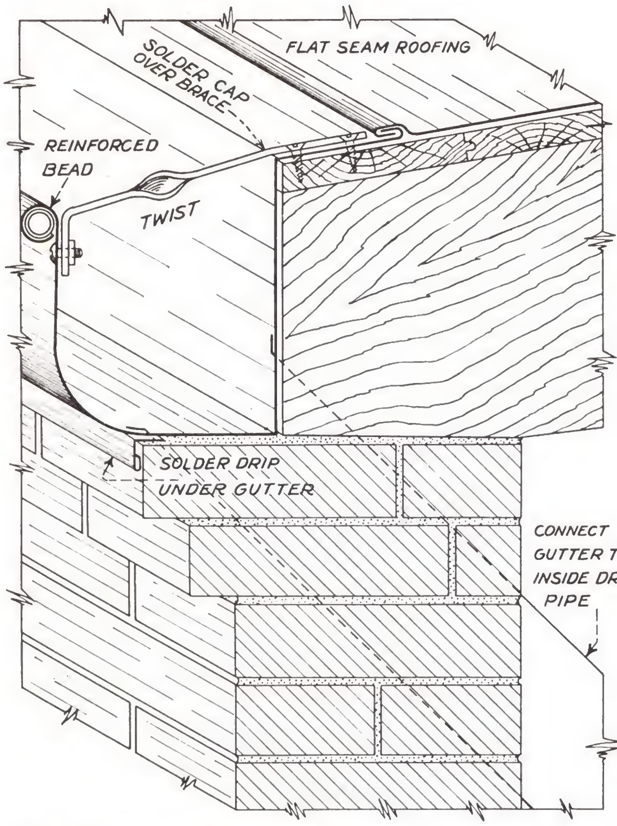


FIG. 1 EAVE GUTTER ON BRICK WALL CONNECTING TO FLAT SEAM ROOFING

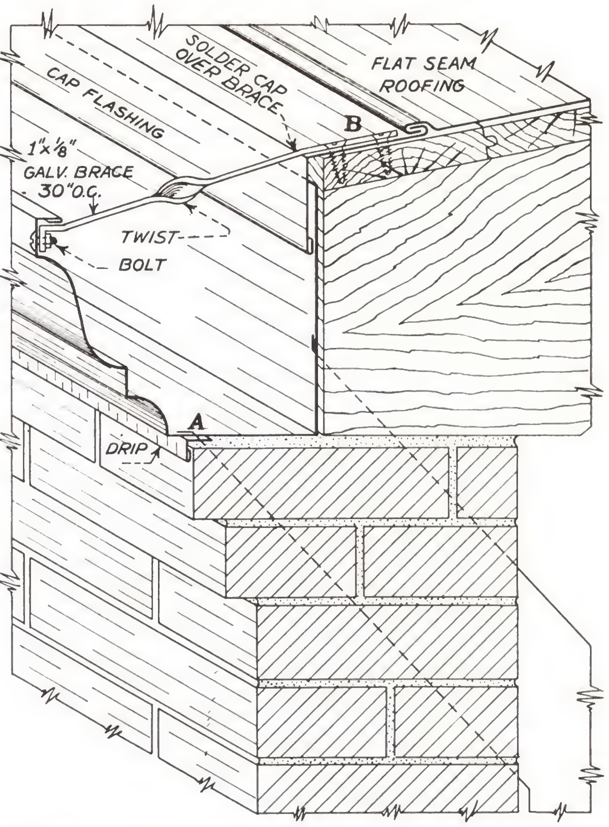


FIG. 2 ANOTHER TYPE OF EAVE GUTTER ON BRICK WALL WITH CAP FLASHING CONNECTING TO FLAT SEAM ROOFING

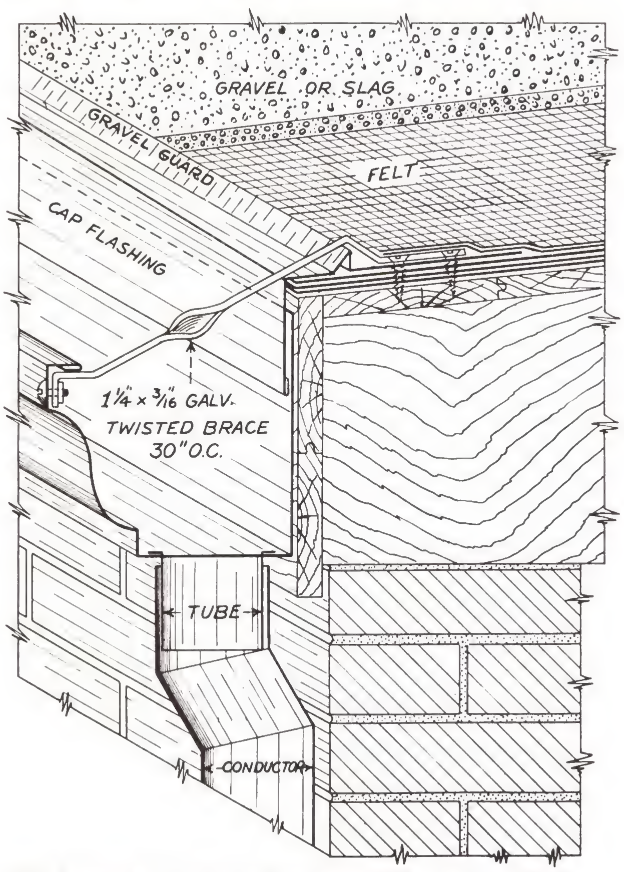


FIG. 3 HANGING GUTTER WITH COMBINATION CAP FLASHING AND GRAVEL GUARD CONNECTING TO COMPOSITION ROOF

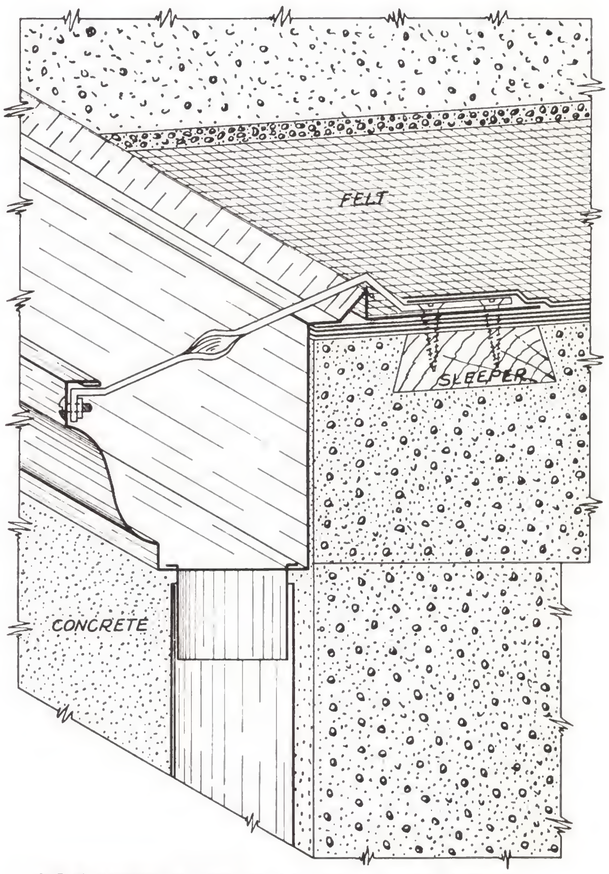


FIG. 4 ANOTHER TYPE OF HANGING GUTTER WITHOUT CAP FLASHING CONNECTING TO COMPOSITION ROOF ON CONCRETE CONSTRUCTION

—NOTE—
SCALE 2" = 1'-0"

DRAWING NUMBER 11 EAVES GUTTERS AT FLAT ROOFS

caulking into the cast iron drain pipe.

Fig. 2 shows the eaves gutter with cap flashing. The front edge of the gutter is at least 1½ in. lower than the top of the upturned flange at the back to prevent overflow. The gutter is applied as in Fig. 1. The cap flashing laps over the back of the gutter not less than 2 in., is edged at the top and cleated to the sheathing and the roof is put on in the usual manner.

A hanging gutter connection to composition roof is shown in Fig. 3. After the under courses of felt have been laid, the combination gravel guard and cap flashing is nailed through the felt.

Band iron gutter hangers are formed to the shape of the gutter, the front bent only up to the bottom of the ogee mold. These hangers are nailed to the facia with proper pitch to the outlets. Band iron braces attached to the top of the gutter are the same as those shown in Fig. 1 and 2.

Over the bracing and flashing the roofing is laid, properly cemented with hot pitch and the gravel or slag is applied in the usual manner.

Fig. 4 shows a gutter with gravel guard attached. This requires no cap flashing or gutter hangers. The proper pitch to the outlets is provided when the gutter is formed. Braces are the same as those shown in Fig. 1, 2 and 3.

Hanging Gutters with Expansion Joint

Drawing No. 12

The hanging gutters shown in Drawing No. 12 are set in wrought iron hangers, with and without expansion joints. This drawing also shows the connections to gooseneck and conductor head, the constructions presented being applicable to all kinds of roofing.

Fig. 1 is the detail of a hanging gutter which permits of the use of expansion joints. This gutter is not secured to the roof and is therefore free to expand and contract. For a galvanized iron gutter, 1½ x ¼-in. galvanized band iron hangers are to be used; for copper gutters, brass hangers are used. The top of the hanger is countersunk in the sheathing, as shown at *A*, and secured with two large flat head wood screws. These are of steel if galvanized band is used or of brass if bands are brass. The hangers are spaced 30 in. on centers, and have a projecting angle at the outer edge as shown at *B*, over which the gutter is hooked. The projecting ¾-in. edge at the back of the gutter is secured to the roof by cleats as shown.

A gutter without expansion joint is presented in Fig. 2. The band iron hangers are attached to the roof the same as Fig. 1. The gutter is formed with a lap extending up to the roof with the edge turned at the top. The brace is attached to the hanger with bolts as shown at *B* and nailed to the roof, capped and soldered at *C*. The brace is twisted as shown at *D* to prevent water flowing over the edge of the gutter. The connection to the conductor head is shown in Fig. 1.

The construction of the expansion joint is given in Fig. 3. It is important that the distance is sufficient to allow for the difference in temperature so that expansion and contraction are unhampered by crowding, but not too great so as to be larger than required.

Eaves Gutters for Various Roofs

Drawing No. 13

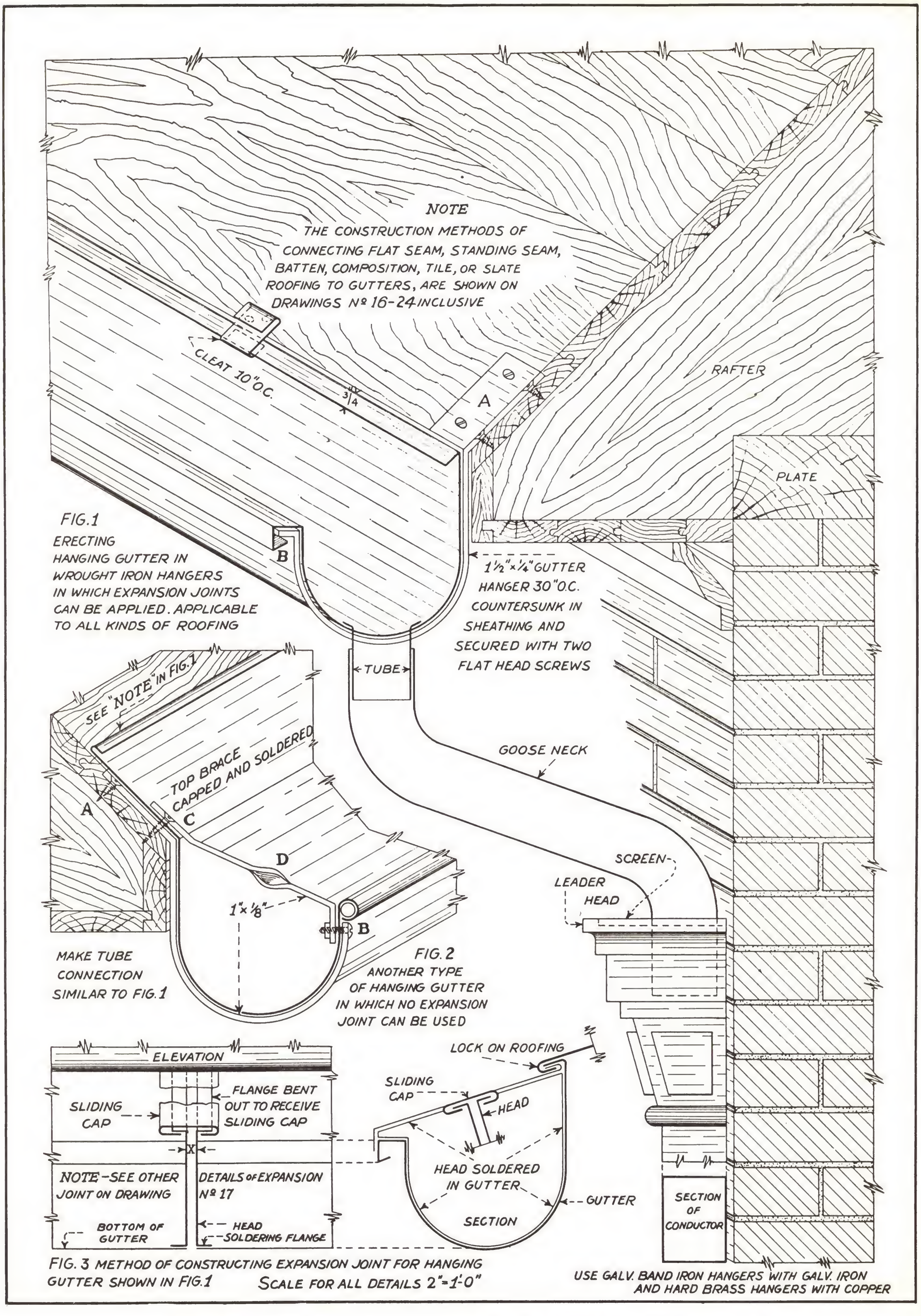
In Drawing No. 13 are presented four types of hanging gutters connecting to flat seam, standing seam, batten and composition roofing.

A half round gutter with single bead reinforced with ⅜-in. rod is shown in Fig. 1. Here the roof flange is part of the gutter with the edge turned up at the top, for securing to the sheathing with cleats. The gutter brace is formed to clasp the bead and secured to sheathing with barbed roofing nails. The brace is capped and soldered to prevent leakage.

The gutter shown in Fig. 2 is similar to that presented in Fig. 1, but minus the reinforced rod in the bead. The roof flange and gravel guard are attached to the top, as shown. The braces are secured to the front of the gutter with round head bolts and nailed to the roof sheathing over gravel guard.

Fig. 3 shows a gutter with a molded front. The roof flange is the same as in Fig. 1. The brace is riveted to the front flange of the gutter at *A* and to the back of the gutter as at *B*. This rivet is protected by solder.

A hanging gutter with cap flashing is shown in Fig. 4. Wood molding is nailed to the facia as shown on the bottom of the gutter for it to rest



DRAWING NUMBER 12

HANGING GUTTERS WITH EXPANSION JOINT

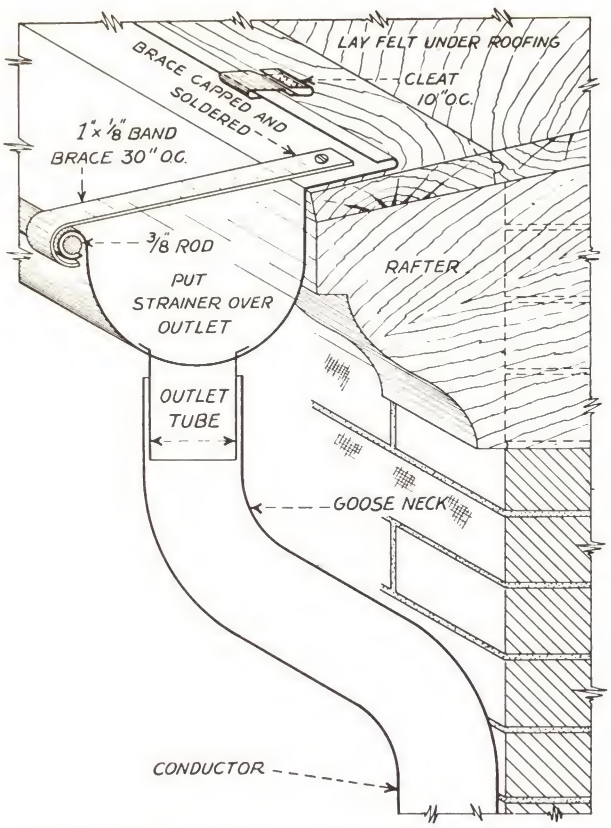


FIG. 1 HANGING GUTTER WHICH CAN BE USED IN CONNECTION WITH FLAT SEAM, STANDING SEAM AND BATTEN ROOFING Scale 2"=1'-0"

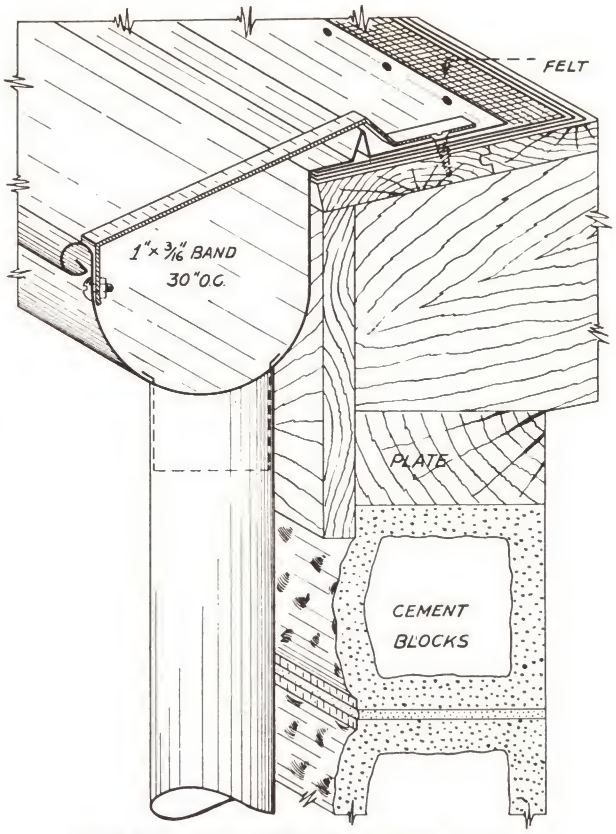


FIG. 2 HANGING GUTTER FOR GRAVEL, SLAG AND FLAT TILE ROOF INSTALLATION Scale 2"=1'-0"

FIG. 3 ANOTHER TYPE OF HANGING GUTTER FOR FLAT SEAM, STANDING SEAM AND BATTEN ROOF INSTALLATION Scale 2"=1'-0"

FIG. 4 HANGING GUTTER WITH CAP FLASHING, FOR FLAT SEAM, STANDING SEAM AND BATTEN ROOF INSTALLATION Scale 2"=1'-0"

NOTE } THE CONSTRUCTION METHODS OF CONNECTING FLAT SEAM, STANDING SEAM, BATTEN, TILE, SLATE AND COMPOSITION ROOFING TO GUTTERS ARE SHOWN ON DRAWINGS № 16-24

Drawing Number 13 EAVES GUTTERS FOR VARIOUS ROOFS

on. The front edge of the gutter is at least $1\frac{1}{2}$ in. lower than the upturned back. The gutter sets on the wood molding and is nailed to the sheathing at the top. The cap flashing is then applied.

The braces, made of 1 x $\frac{1}{8}$-in. band iron and spaced 30 in. on centers, are attached to the front of the gutter with round head bolts and nailed to the roof sheathing with two barbed roofing nails. These braces are properly capped and soldered.

Eaves Troughs and Hangers for Various Roofs

Drawing No. 14

Four types of eaves troughs and hangers for connection to any kind of roof installation as well as the method for constructing the expansion joint in the eaves trough, are presented in Drawing No. 14.

In Fig. 1 is shown an eaves trough with double bead with hanger for pitched roof construction. The eaves strip is shown at *X*. This eaves trough may be used with either a flat lock or standing seam roof. The hanger is made of $\frac{1}{8}$ x 1-in. band iron. The brace is constructed to accurately surround both gutter beads. The vertical band is riveted to the center of the brace, bent to the proper angle of the roof, allowing for pitch to the outlets. The hanger is nailed to the roof sheathing with two barbed wire roofing nails. If a metal roof is used, then the hanger is capped and soldered.

An eaves trough with a double bead is presented in Fig. 2. The gravel stop and drip is applied to the roof as shown. The hanger is similar to that shown in Fig. 1, except that both the brace and hanger are twisted. This hanger is applied to the gutter the same as in Fig. 1 and also attached to the roof in the same way.

Eaves trough hangers for flat tile roofing are shown in Fig. 3 and 4, which give the single and double bead eaves trough. The hangers are regular commercial wire eaves trough hangers and are applied as shown. These may be used on small gutters requiring only light duty and draining roofs of small area.

Fig. 5 presents the method of constructing the expansion joint in the eaves trough. The upper part of the illustration shows two heads soldered in the ends of the eaves trough, the distance marked *X* being allowed between the heads, to provide for temperature variation. The lower part shows the space between the two heads marked *C* and *D* with expansion and sliding cap covering them.

Eaves Troughs Erected with Adjustable Hangers

Drawing No. 15

Some examples of eaves troughs erected in cast hangers with adjustable shanks for any pitch of roof and for any type of roof installation, are presented in Drawing No. 15.

Fig. 1 shows the adjustable shank driven into the joint of the brick or stone wall. The combined metal eaves strip and drip is nailed to the edge of the sheathing and metal roofing is locked to the projecting edge of the strip as at *A*. This is turned down as shown by *A′* in the diagram below. The turning down of the lock also covers the nail heads. The hangers are attached to the shank with bolts and are graded to allow pitch of the gutter to the outlets.

A roof construction with box cornice is shown in Fig. 2. The shank is screwed to the woodwork, as indicated. The metal eaves strip which covers the projecting beam is nailed at *A* on the bottom and covered with wood molding. It is also nailed at the upper edge of the roof. This type of eaves flashing is applicable to composition or flat tile roofs. Over this flashing the roofing is applied, and the gutters are attached to the hanger the same as shown in Fig. 1.

In Fig. 3 the shank is screwed to the side of the projecting rafter. The eaves strip is formed as shown and nailed to the roof sheathing. Over the projecting flange *A* either standing seam or a flat lock roofing is applied. The edge of the eaves strip is turned down, as the edge *A* acts as a drip. The gutter hangers are again applied as in Fig. 1 and 2.

As shown in Fig. 4, the combination cant and eaves strip is applied as at *B*, and the adjustable shank is nailed to the roof sheathing before the slate is applied, as shown in the broken view, 1, 2 and 3. The gutter hangers are applied in the same way as shown in Fig. 1, 2 and 3.

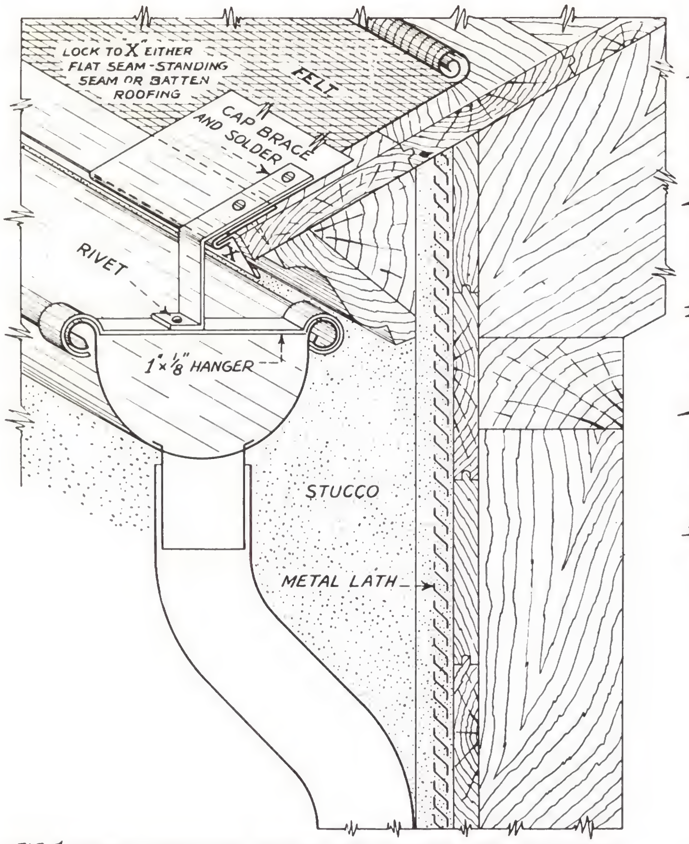


FIG. 1 DOUBLE BEAD EAVE TROUGH WITH HANGER FOR FLAT SEAM, STANDING SEAM AND BATTEN ROOF INSTALLATION
SCALE 2"=1'-0"

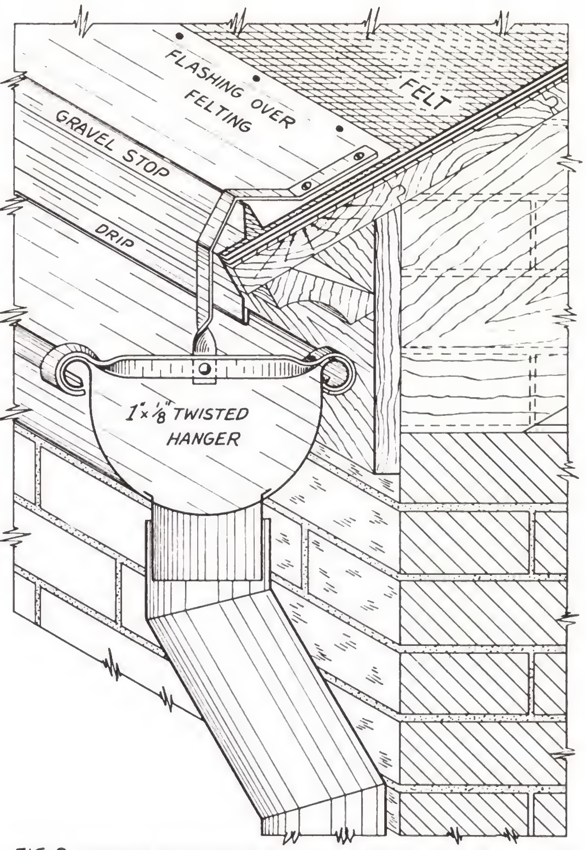


FIG. 2 DOUBLE BEAD EAVE TROUGH WITH TWISTED HANGER FOR COMPOSITION AND FLAT TILE ROOF INSTALLATION
SCALE 2"=1'0"

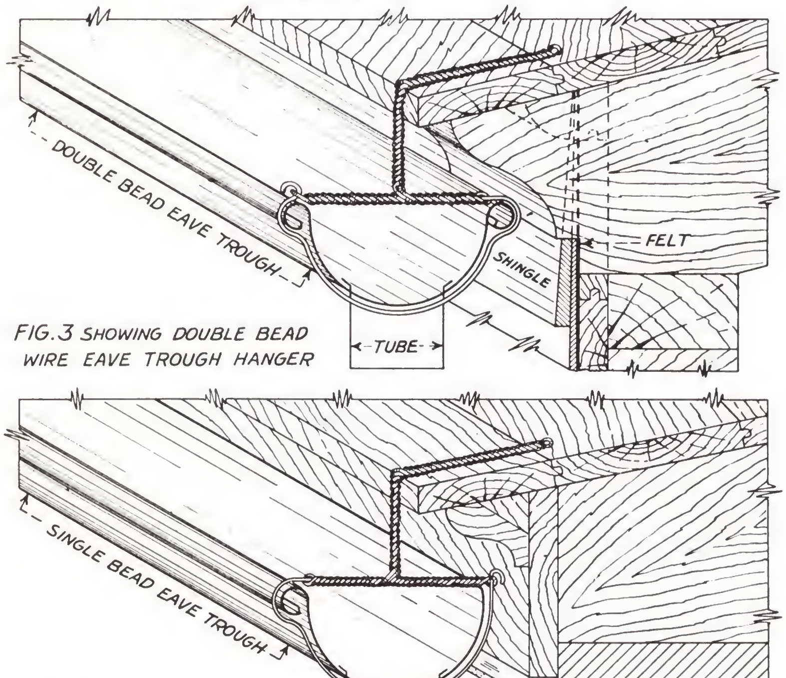
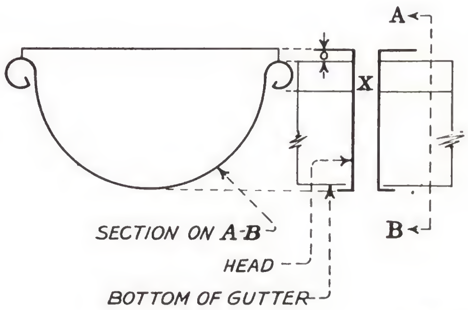


FIG. 3 SHOWING DOUBLE BEAD WIRE EAVE TROUGH HANGER



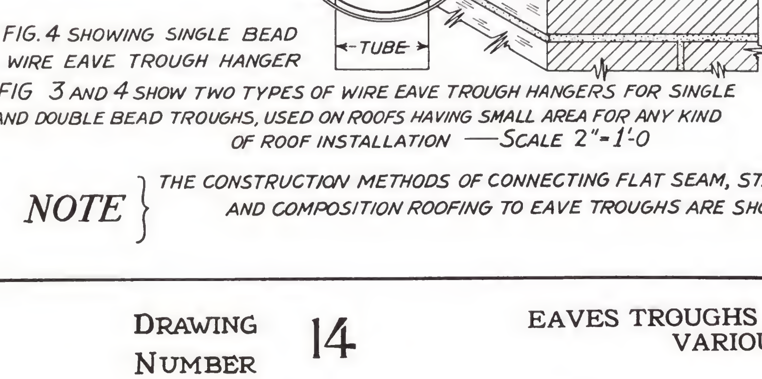


FIG. 4 SHOWING SINGLE BEAD WIRE EAVE TROUGH HANGER

FIG 3 AND 4 SHOW TWO TYPES OF WIRE EAVE TROUGH HANGERS FOR SINGLE AND DOUBLE BEAD TROUGHS, USED ON ROOFS HAVING SMALL AREA FOR ANY KIND OF ROOF INSTALLATION —SCALE 2"=1'-0

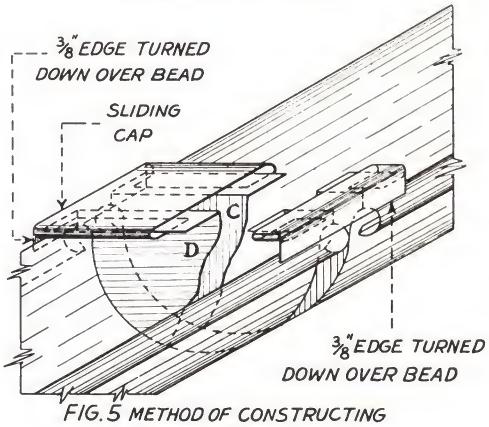


FIG. 5 METHOD OF CONSTRUCTING EXPANSION JOINT IN EAVE TROUGH
—— SCALE-2"=1'0" ——

NOTE } THE CONSTRUCTION METHODS OF CONNECTING FLAT SEAM, STANDING SEAM, BATTEN, TILE, SLATE AND COMPOSITION ROOFING TO EAVE TROUGHS ARE SHOWN ON DRAWINGS Nº 16 - 24

DRAWING NUMBER 14

EAVES TROUGHS AND HANGERS FOR VARIOUS ROOFS

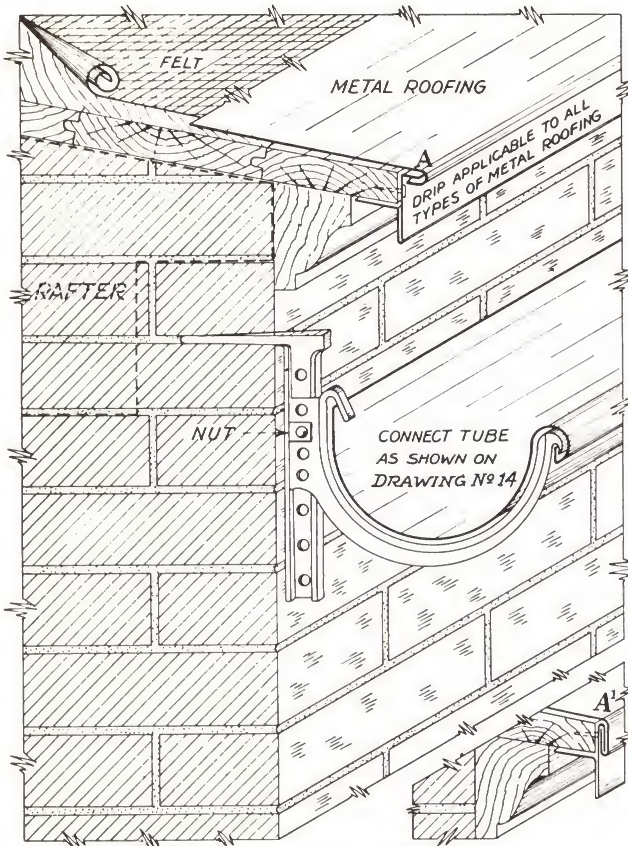


FIG. 1 SINGLE BEAD EAVE TROUGH IN CAST HANGER HAVING ADJUSTABLE SHANK TO DRIVE IN BRICK OR STONE WALL SCALE - 2"=1'-0"

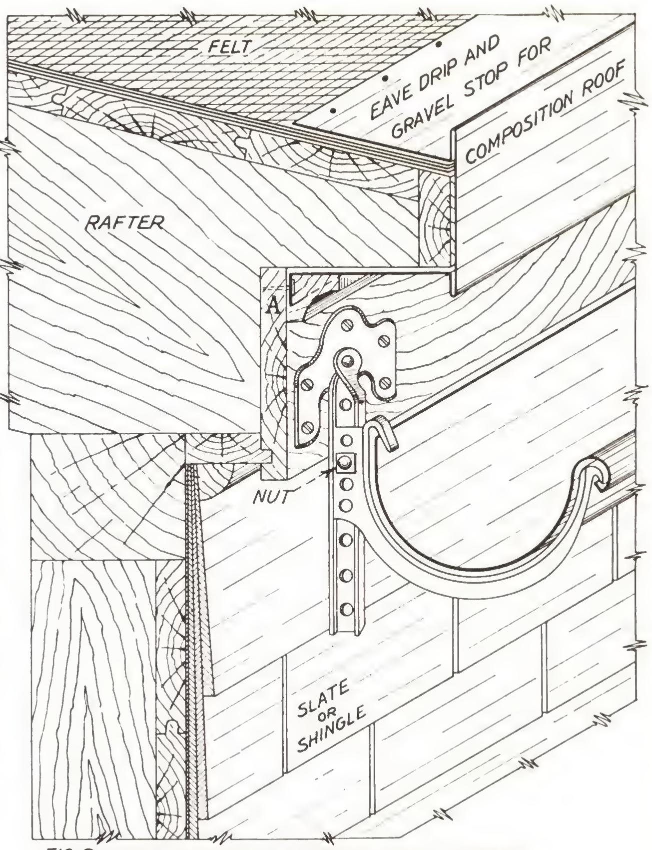


FIG 2 SINGLE BEAD EAVE TROUGH IN CAST HANGER HAVING ADJUSTABLE SHANK TO SCREW AGAINST SQUARE BOX CORNICE — SCALE -2"=1'-0"

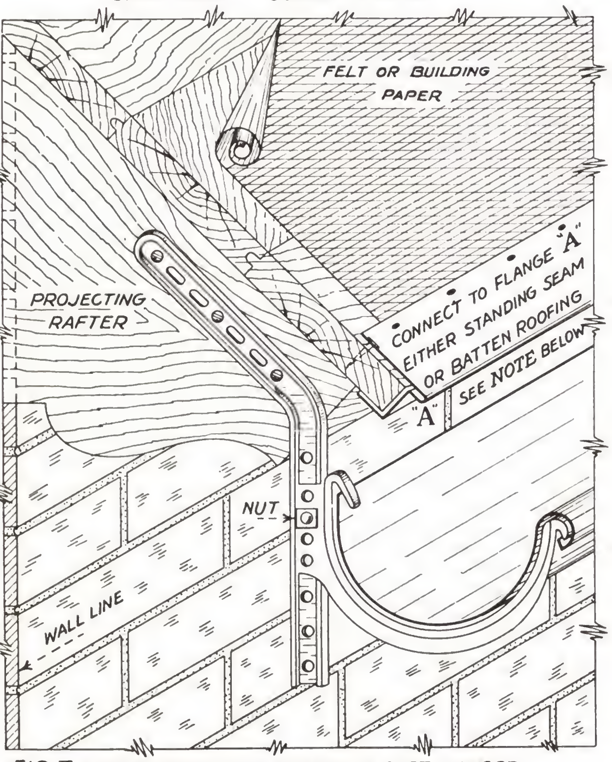


FIG. 3 SINGLE BEAD EAVE TROUGH IN CAST HANGER HAVING ADJUSTABLE SHANK TO SCREW AGAINST EXPOSED RAFTER - SCALE - 2"=1'-0" —

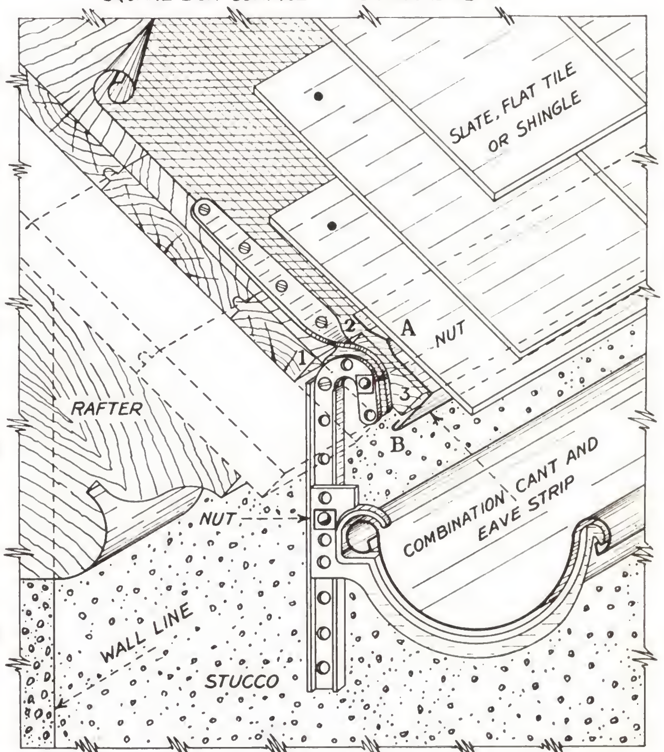


FIG 4 DOUBLE BEAD EAVE TROUGH IN CAST HANGER HAVING ADJUSTABLE SHANK TO SCREW UNDER SLATE, FLAT TILE OR SHINGLE —SCALE - 2"=1'-0"—

NOTE } THE CONSTRUCTION METHODS OF CONNECTING FLAT SEAM, STANDING SEAM, BATTEN, TILE, SLATE AND COMPOSITION ROOFING TO EAVE TROUGHS ARE SHOWN ON DRAWING Nº 16-24

DRAWING NUMBER 15 — EAVES TROUGHS ERECTED WITH ADJUSTABLE HANGERS

Box Gutter Lining

Drawing No. 16

The details in Drawing No. 16 show the method of lining wood sheathed box gutters with sheet metal and connecting them to sheet metal or wood cornices and flat seam roofing.

Fig. 1 shows how the gutter is formed on sheathing laid inside of a sheet metal cornice. The cornice is constructed with a drip at *A* in the foot mold, with projecting edge at *X* above the crown mold. When the wall is built to the bottom line of the foot mold at *A*, a space of 4 in. (one course of bricks) is left and then the wall carried up as high as *F* to receive the wooden lookouts for the gutter. The wall is then continued and the rafters set. Thus there is an open space of 4 in. from *A* upward. The braces are located on the wall and wall hooks driven in the brick joint as at *B*, with the top of the hook turned inward as at C. The lower anchor on the cornice also has an acute angle as at *D*.

The cornice is set on the wall and the drip drawn snugly against the wall line by twisting the wire as at *E*. The cornice is set plumb and true by temporary fastenings and the anchor *F* bolted to the brace as at *G*. The brick wall is completed in the 4-in. space up to the top of the rafter, which holds the cornice in position.

In sheathing the gutter it is essential that all nails are driven flush and the proper grade given to the outlets. Note that there are no right angular corners in the gutter. The sheet metal gutter lining is locked to the front edge of the metal cornice as shown and turned on the roof with a lock secured with cleats. All cross seams in the gutter are cleated.

As shown at *a* the upper flange of the cornice is nailed in a straight line about 2 or 3 in. apart.

Fig. 2 shows how the gutter lining is connected to the wood cornice to allow for expansion and contraction and to avoid nailing along the front gutter edge, as is frequently done. Two methods are shown. The first one, *A*, consists of a double fold angle nailed to the top of the cornice as at *b* to which the gutter lining is locked. In the other method presented in Fig. 3, a single angle is employed with a hem edge at the bottom as shown, nailed to the front edge of the crown mold as at *C* to which the lining is locked. To cover the nail heads, the lock is turned down as shown at *B* in Fig. 4.

Expansion Joint for Box Gutter Lining

Drawing No. 17

In Drawing No. 17 is shown how the lock is made between flat seam roofing and box gutter lining so that the expansion joints may be constructed at both high and low points of the gutter lining.

Fig. 1 shows the construction of the lock at the eaves line joining the gutter lining. While a flat seam roof is here shown, this lock is used also with standing seam and batten roofing. It is also used in connection with the eaves strip on composition, flat tile, slate and Spanish tile roofs.

The upper part of the metal cornice shown in Fig. 1 has a roof flange as indicated at *A*, which is nailed to the sheathing. Over this flange the gutter lining locks as at *B*. At the eaves of the roof the gutter lining is turned out $5/8$ in. as shown at *C*. The flange *C* is secured every 8 or 10 in. with cleats, as at *D*, over which the roofing sheets are locked as indicated at *E*. Note the small drip bent on the roofing lock at *F*, which prevents capillary attraction.

To allow for the expansion and contraction of the gutter in its length, expansion joints are placed at the high and low points of the gutter. When the head is soldered in, the upper flange extends below the gutter flange a distance equal to *W*. The height at *X* is just enough to permit the locks on both sides of the sliding cap to slip in with ease, which is clearly indicated in Fig. 2 and 3.

In Fig. 2 is shown the connection of the heads and sliding cap at the upper end of the gutter, under the gutter flange at the eaves. Note that the sliding cap has an upturned lock at *A*, which slips under the $5/8$-in. outward turned flange of the gutter lining, as shown at the left and over this gutter flange and lock of the sliding cap, the roofing is locked. Where the roofing fastens over the lock of the sliding cap, the drip shown at *B* is notched out.

Fig. 3 shows clearly the connection of the heads and sliding cap at the lower end of the gutter where it joins the cornice flange. Note the broken view along *B-C-D*. The height of the head at *F* is exaggerated. It should be high enough to allow the lock *D* to slip in with ease.

To prevent the rain water from following the

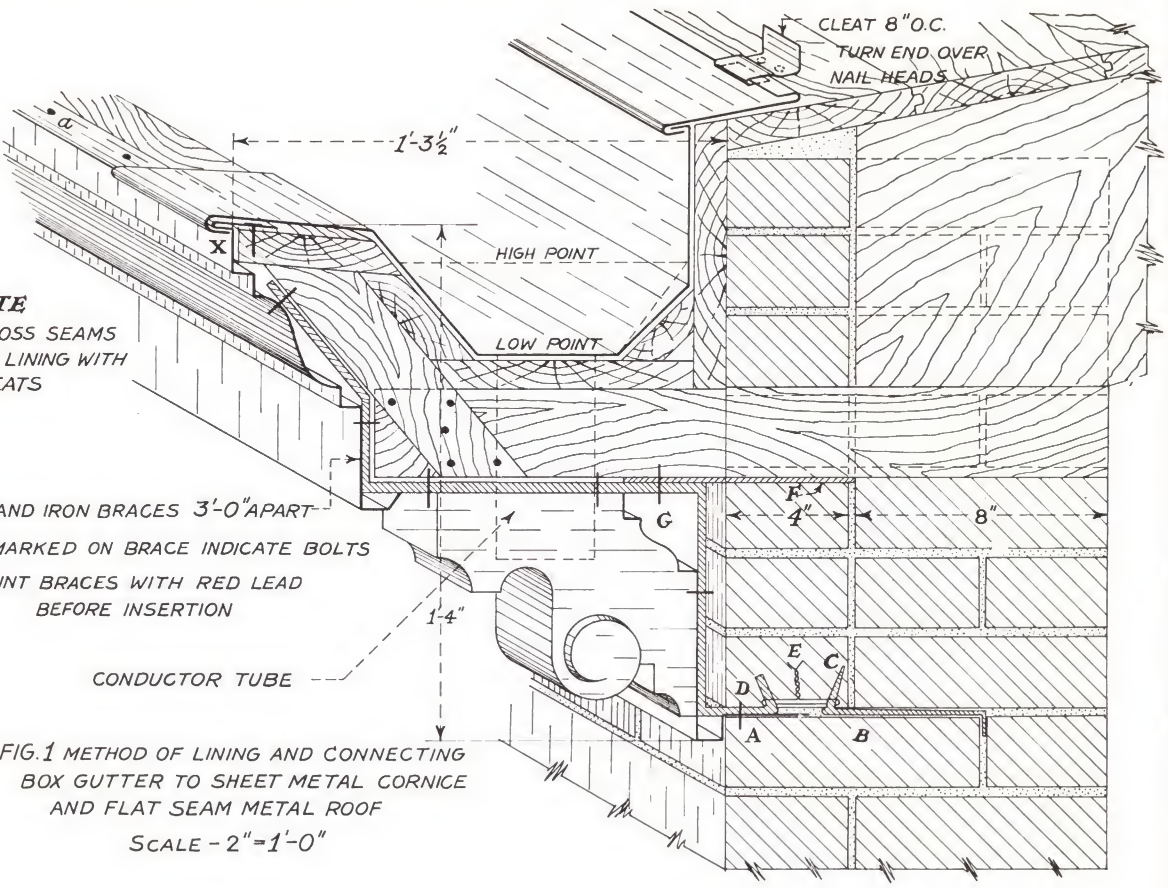
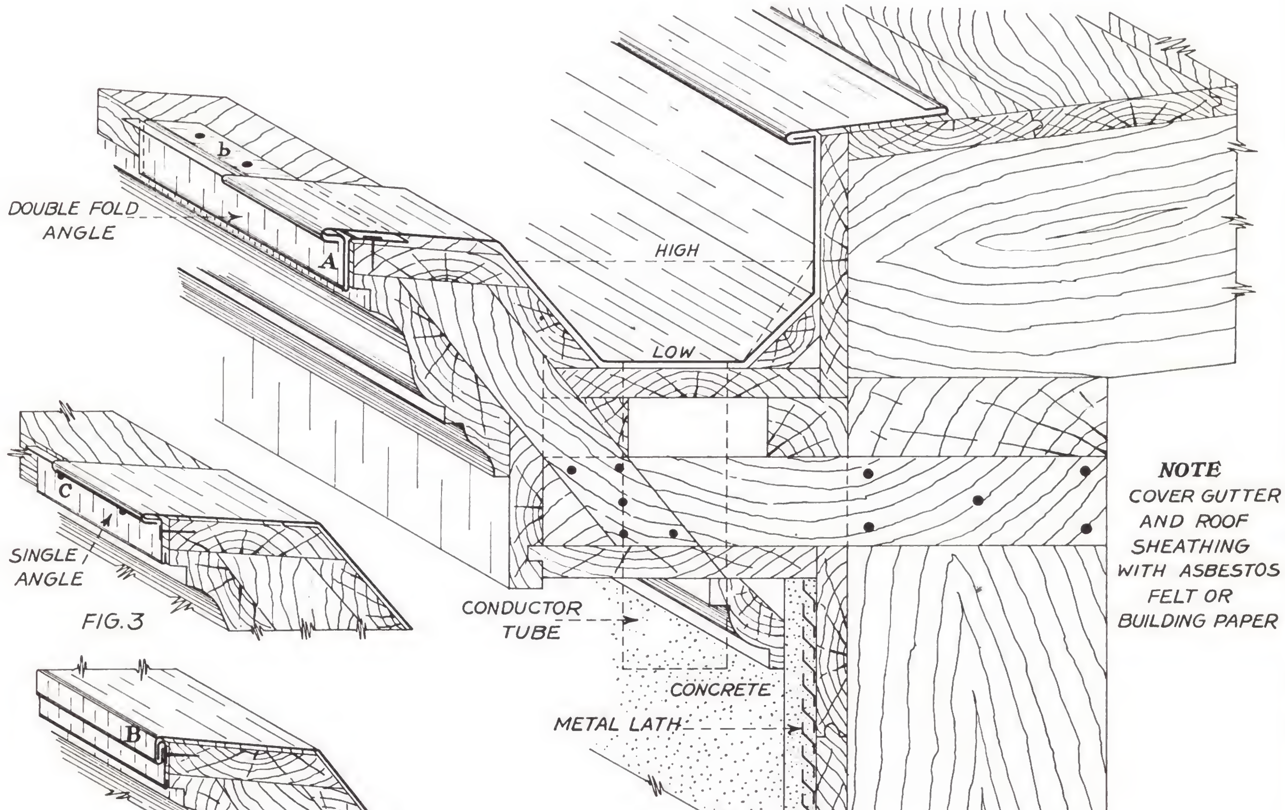
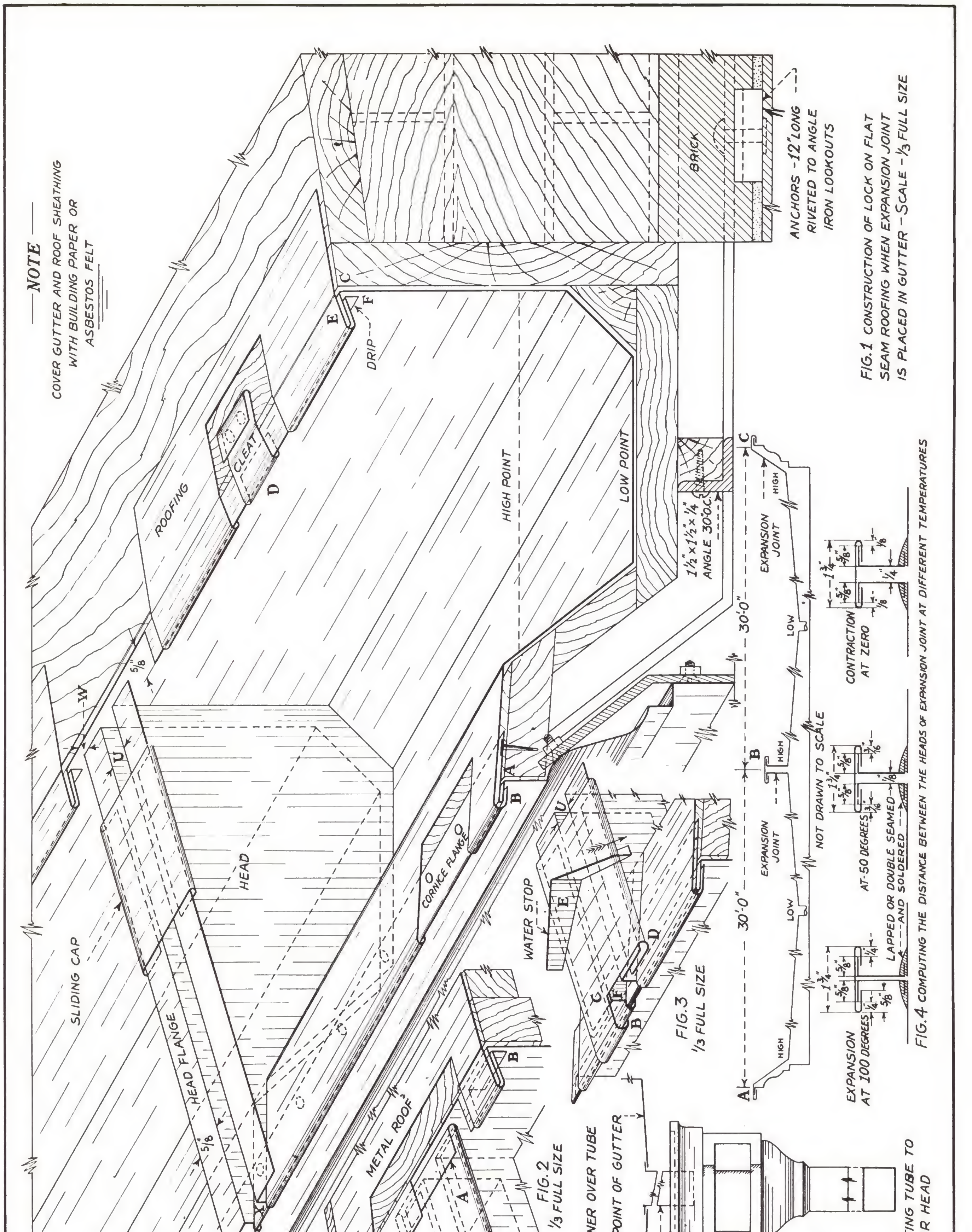


FIG. 1 METHOD OF LINING AND CONNECTING BOX GUTTER TO SHEET METAL CORNICE AND FLAT SEAM METAL ROOF
SCALE - 2"=1'-0"



SCALE - 2"=1'-0" FOR FIG. 2-3 AND 4

FIG. 2 METHOD OF LINING AND CONNECTING BOX GUTTER TO WOOD CORNICE AND FLAT SEAM METAL ROOF



DRAWING NUMBER 17 EXPANSION JOINT FOR BOX GUTTER LINING

sliding cap and dripping over the edge of the cornice, a water stop E is placed at the lower end, which sheds the water on each side into the gutter, as indicated by the arrow.

Assuming that the gutter is 60 ft. long and there are two leaders or conductors, as shown in Fig. 4, and that copper is used for the lining, as the sheet copper expands and contracts approximately 1/8 in. for every 10 ft. in a rise of temperature from Zero to 100 deg., 60 ft. will expand or contract 3/4 in. This is taken care of by three expansion joints, A, B and C, which allow for 1/4 in. each. Note that the distance between the heads, as at U in Fig. 1, 2 and 3, is determined by the temperature at the time the work is erected. If each run of the gutter is 30 ft., as shown in Fig. 4, and the space allowed at each expansion joint is 1/4 in., then if the work is being erected at a temperature of 50 deg., the minimum distance required between the heads is 1/8 in., as shown in the lower center diagram.

Fig. 5 shows a 1-in. scale drawing of the outlet tube at the low point of the gutter, connecting to the leader head.

Box Gutter Lining at Standing Seam Roof

Drawing No. 18

The methods of making connections between standing seam roofing, joining the lock on the flange of the gutter lining turned over the roof, locking the roofing to the edge turned on back of the gutter lining and securing to metal eaves strip fastened to the eaves of the roof, are presented in Drawing No. 18.

Fig. 1 shows the construction of a wood cornice over shingled siding. A double fold metal angle is nailed along the top edge of the cornice, as shown, to which the gutter lining is locked. In this construction, the gutter lining is turned over on the roof with a lock edged, as shown, to which the standing seam roofing is locked. If the roof is quite flat and it is necessary to solder the cross seams as well as the seam joining the gutter lining, then no expansion joints are placed in the gutter, because it is firmly secured to the roofing by means of the flange turning over on the roof. If, however, the roof is quite steep and it is not necessary to solder the cross seams, then expansion joints are placed in the gutter similar to the construction explained in connection with Drawing No. 17, except that the upper line of the head runs from A to B in Fig. 1 on Drawing No. 18, allowing the sliding cap to slip under the lock of the gutter lining at A. If the butt of the standing seam is to be turned down, the appearance is like X. Cleats are placed along seam of gutter lining about 8 in. apart, as shown at Y. When the roof is quite flat and expansion joints are required, then the gutter lining is bent, as shown in Fig. 2, with a 5/8-in. edge turned outward at the top of the gutter lining as at C, to which the roofing is locked. The expansion joints are made as shown on Drawing No. 17.

Fig. 3 shows the metal roofing locked to the eaves strip nailed along the eaves of a roof on which no gutter is desired.

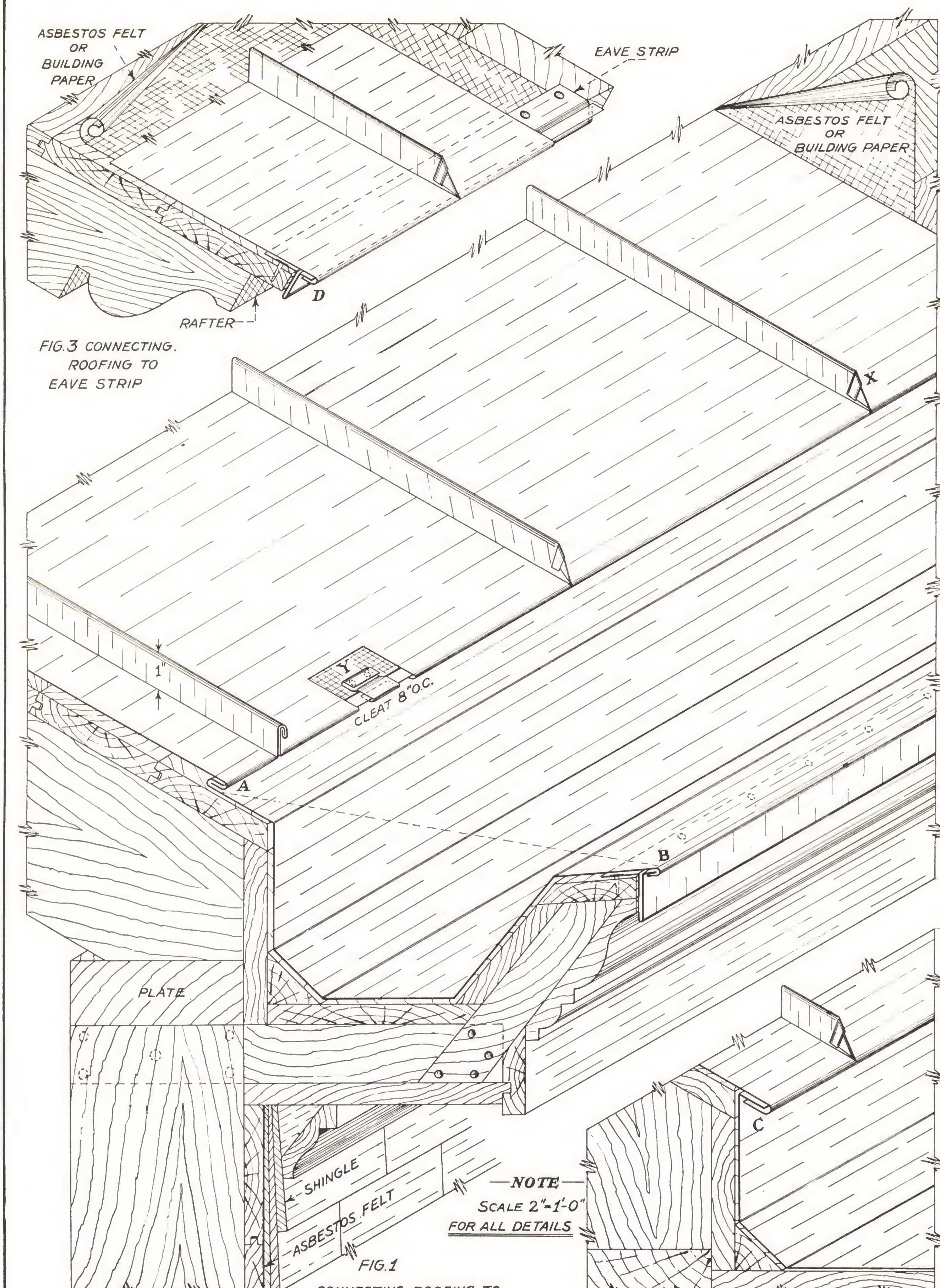


FIG.3 CONNECTING ROOFING TO EAVE STRIP

FIG.1 CONNECTING ROOFING TO LOCK ON FLANGE OF GUTTER LINING TURNED OVER ON ROOF

FIG. 2 LOCKING ROOF TO EDGE TURNED ON BACK OF GUTTER LINING

DRAWING NUMBER 18

BOX GUTTER LINING AT STANDING SEAM ROOF

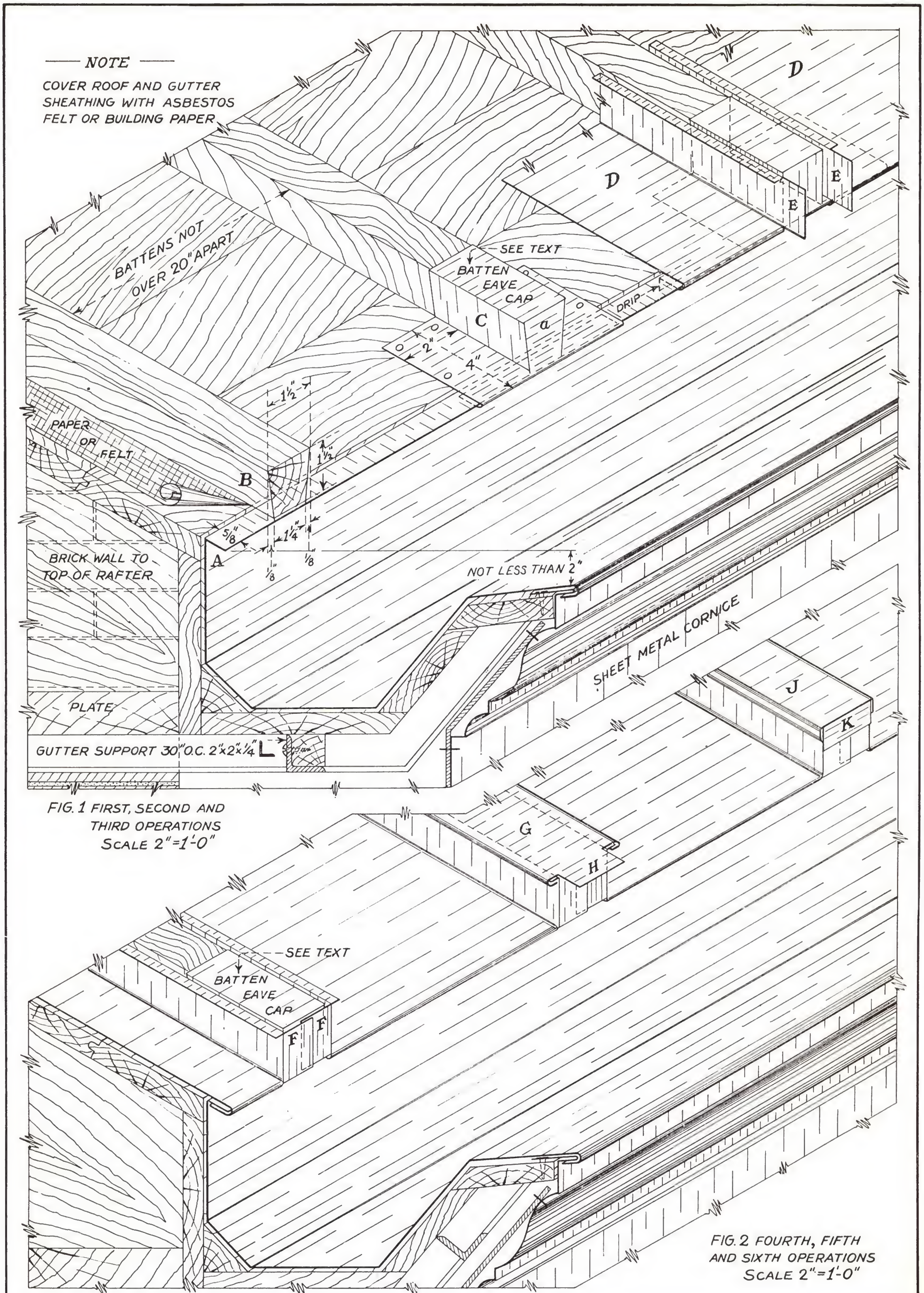


FIG. 1 FIRST, SECOND AND THIRD OPERATIONS
SCALE 2"=1'-0"

FIG. 2 FOURTH, FIFTH AND SIXTH OPERATIONS
SCALE 2"=1'-0"

DRAWING NUMBER 19 BATTEN ROOF CONNECTIONS TO GUTTER

Batten Roof Connections to Gutter

Drawing No. 19

Drawing No. 19 shows how connections are made between the gutter lining and batten roof, providing for horizontal expansion and contraction of the sheets between the battens.

When metal roofing is laid over battens the usual practice is to solder the overlaps shown by *F-F* in Fig. 2. While this is permissible when tin or galvanized iron is used for the covering, as there is practically no expansion and contraction in the 20 or 24-in. space between the battens, this method is not employed when copper or zinc is used. When copper or zinc batten roofing is laid, full allowance is made for the expansion and contraction of the metal both horizontally and vertically. On copper or zinc roof covering, the soldering of the overlaps holds the sheets rigid and firm at the eaves and prevents free movement of the metal sheets between the battens at the eaves line which defeats the very object for which the battens were cut tapered at the base as shown in *B*, Fig. 1, where a 1/8-in. taper is given on both sides of the batten.

To avoid any soldering at the eaves of the batten strip, six progressive steps in the application of the sheet metal are shown in Fig. 1 and 2. Note in Fig. 1 that the back of the gutter is flanged outward as at *A* and the batten strip *B* is placed flush with the outer edge of this flange.

At the lower end of each batten, a batten eaves cap is nailed as shown by *C*. This eaves cap locks to the projecting gutter flange and is made to lap the roof about 2 in. on each side and is 4 in. long. These are formed and the head *a* soldered in at the shop, brought to the job and slipped over the wood battens before the roofing is laid. The roofing sheets *D-D* are laid with cleats 8 to 10 in. apart as previously explained, and the lower ends notched as shown by *E-E*. Note that the locks at the lower ends of the roofing sheets overlap both the lock of the batten cap and the gutter flange. The ends *E-E* are turned over as shown at *F-F* in Fig. 2, *but not soldered.* The cap is then slipped over as shown by *G* and notched at the lower end as at *H*. The double seam is made at the sides of the batten and the edge *H* turned down at *J* and *K*.

Box Gutter Lining at Slate Roofing

Drawing No. 20

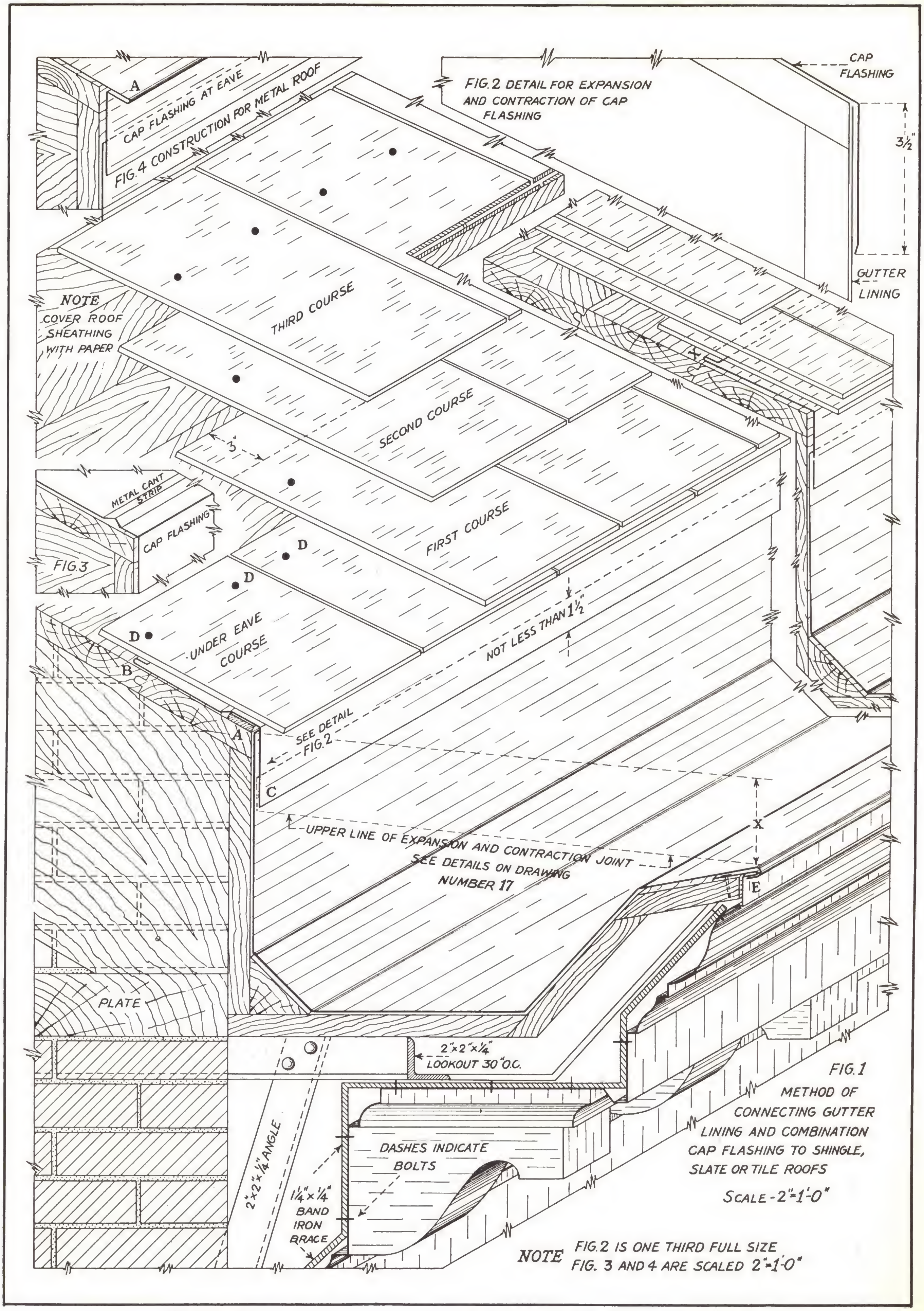
During the process of construction box gutter linings of tin, zinc, copper or galvanized iron, particularly when the roof is covered with slate, tile or sheet metal, are more liable to damage than at any time after the completion of the job. To overcome this hazard, the gutter lining may be laid after the entire roof is completed by following the procedure shown in Drawing No. 20.

After the sheet metal cornice is set and the roof and gutter sheathed, a cant strip indicated by *A* about 1 x 1/4-in. in section is nailed along the eaves of the roof. Over this a roof flange and cap flashing are set, flanged on the roof not less than 6 in. with a lock edge turned at *B*, which is secured to the roof by means of 1 in. wide cleats placed 10 in. apart and the cap flashing turned into the box gutter not less than 3½ in., as shown at *C*. After the cap flashing is secured with cleats hooked into the lock *B* in Fig. 1, the roof is covered with approved felt. The under eaves course of slate is laid to project about 1 in. over the eaves line, care being taken to have the slate nail *D* above the lock *B*. If desired, the cant strip is formed in the sheet metal cap flashing as shown in Fig. 3.

Another method is to omit the cant strip entirely and start with the under eaves course of slate, closing down the lock *X* after it is cleated. The lining slips under the cap flashing at *C*, not less than 1½ in. as shown in Fig. 2.

In constructing the gutter in Fig. 1, the upper point of the back of the lining is not less than 2 in. higher than the lock of the gutter with the cornice at *E*, as shown at *X*, so that in case of overflow, the water will run over the front at *E*, before it runs behind the lining at *A*. If expansion joints are required, the upper line of the expansion cap extends under the lower line of the cap flashing at *C* and is flanged up behind the cap flashing as shown by the dotted line. The construction of the expansion joint is similar to that shown on Drawing No. 17.

Fig. 4 shows the construction of the cap flashing for a metal roof.



DRAWING NUMBER 20

BOX GUTTER LINING AT SLATE ROOFING

Gutter Linings and Flashings at Composition Roofing

Drawing No. 21

In Fig. 1 is shown a combination gravel stop and cap flashing. The main cornice in this case is of metal to which the gutter lining locks at *A* and turns up at the back as far as *B*. After the three-ply felt has been laid, the combination gravel stop and cap flashing shown at *C* is nailed to the roof as indicated and over this the two-ply felt is cemented with hot pitch or asphalt and the slag or gravel applied. If expansion joints are required in the gutter, the upper line of the sliding cap is placed as indicated by the dotted line *D-E*, locking the low end of the cap over the lock at *A* and flashing up at the high end between the gutter lining *B* and cap flashing *D*, as shown on Drawing No. 17.

The outer edges of the gutter at *A* are at least 2 in. below the upper edges of the back of the gutter lining at *B*, so that in case of an overflow the water runs over the front edge of the gutter and not behind the gutter lining at *B*.

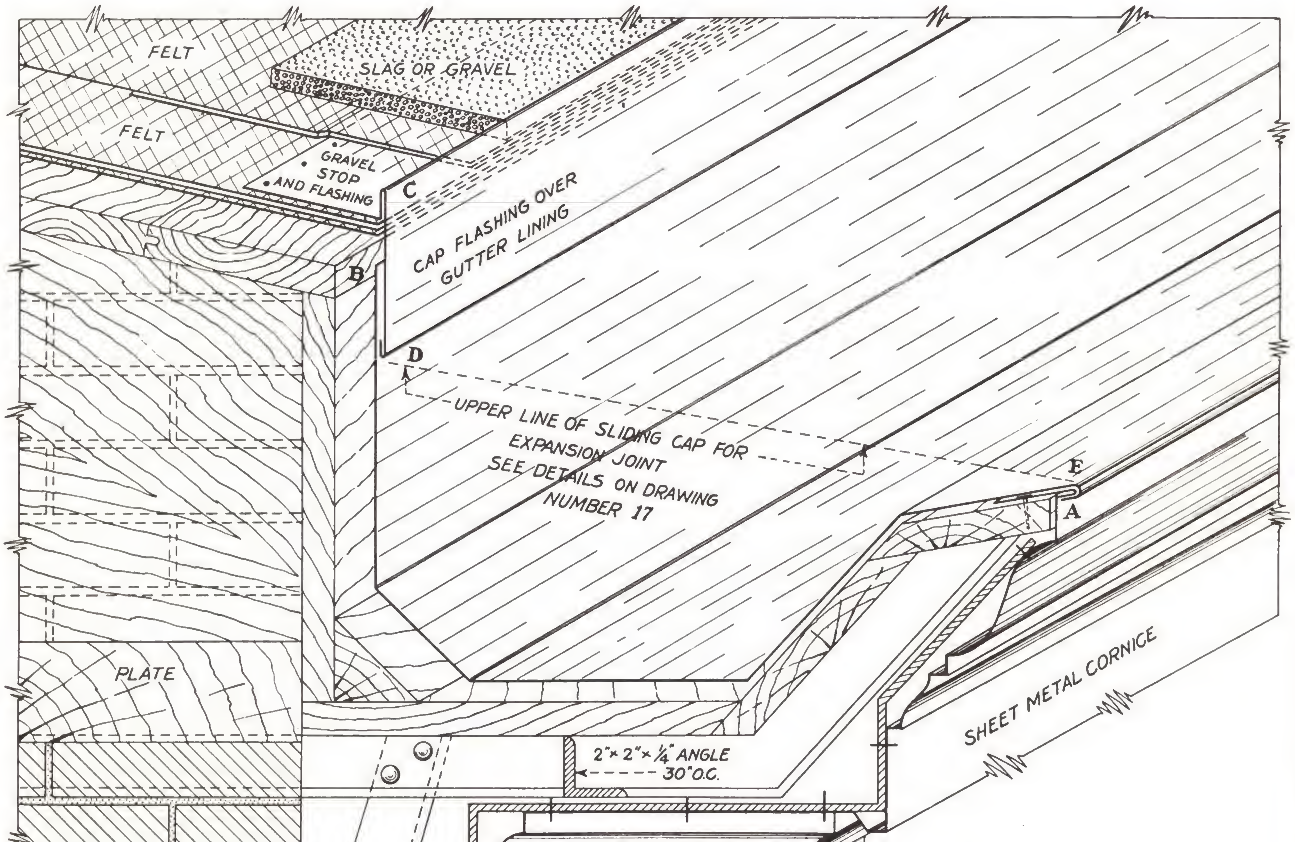


FIG.1 COMBINATION GRAVEL STOP AND CAP FLASHING USED IN CONNECTION WITH COMPOSITION ROOFING AND BOX GUTTER LINING
SCALE-2"=1'-0"

DRAWING NUMBER 21 — GUTTER LININGS AND FLASHINGS AT COMPOSITION ROOFING

Flashing Used at Tile Deck Roofing

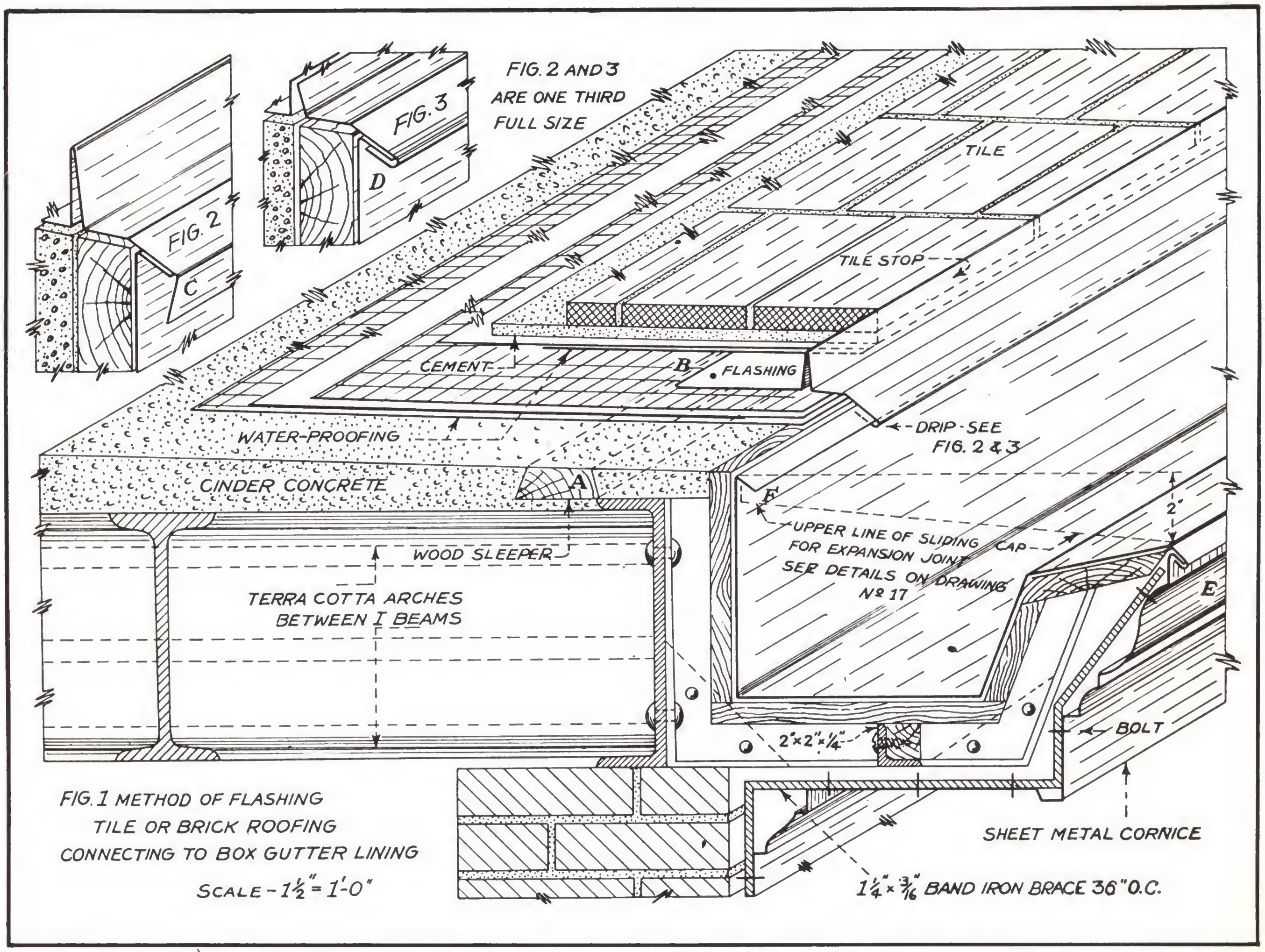
Drawing No. 24

In Drawing No. 24 is shown how flashings are applied when used in connection with tile roofing on flat roofs.

Fig. 1 shows the method of flashing tile roofs connecting to a box gutter lining. If the cornice illustrated is made of galvanized iron and the gutter lining is of copper, great care is required to heavily tin both sides of the lock *E* to the gutter lining before locking to the edge of the crown molding. In this case the tile roofing is laid on a concrete base.

Over the terra cotta arches, which are placed between the I-beams, cinder concrete is graded to the gutter after the wood sleeper *A* has been placed in its proper position to receive the nailing of the flashing. Then the combination flashing, tile stop and drip is nailed in position as shown at *B*, the outer edge of the drip bent as shown at *C* in Fig. 2, which allows the gutter lining to be laid after the roof is completed.

In lining box gutters, the cornice is locked at *E*, as above described, and a ¾-in. flange turned out as shown at *F*. This flange *F* is slipped under the edge *C* in Fig. 2 and then closed with roofing tongs in the position indicated by *D* in Fig. 3. All cross seams in the gutter lining are locked, cleated and thoroughly soldered.



Drawing Number 24 FLASHING USED AT TILE DECK ROOFING

Gutter Linings on Stone Cornice

Drawing No. 27

Drawing No. 27 illustrates the methods of procedure when a gutter is formed in a stone cornice and when the gutter is built up on top of the cornice.

The details for lining a gutter in a stone cornice are presented in Fig. 1. In this case the stone is cut out to receive the lining, the proper pitch to the outlet carefully graded with concrete. At the front edge of the cornice a reglet is cut about 1 in. deep and ½ in. wide, dovetail in shape, into which a standing strip is placed, the reglet filled with molten lead and then caulked. This strip is provided for the purpose of allowing the gutter lining to be locked to the front edge, as shown in Fig. 2.

After the gutter is lined, as shown in Fig. 1, a cap flashing is placed over it and flanged in the reglet cut in the stone facing not less than 1½ in. and secured with lead plugs about 1 in. wide, spaced about 10 in. apart. The space between the plugs is filled with roofers' elastic cement to match the color of the stone or brick work. The construction of the lining is such that the lower edge of the cap flashing is not less than 2 in. above the front edge of the gutter.

If the gutter outlet is connected to an inside drain, a lead gooseneck is used as shown in Fig. 1, and a brass ferrule soldered to same to allow it to be caulked into the iron drain by the plumber. The lead gooseneck is flanged and soldered to the lining, as indicated in the illustration.

Fig. 3 shows the methods of building a gutter on top of a stone cornice. A reglet is cut in the cornice into which the flange of the top mold is placed and caulked as already explained. Back of this metal mold is blocking and wood sheathing, secured to wood furring, which in turn is secured to the stone cornice with expansion bolts.

The gutter lining is locked to the front flange of the sheet metal mold and a ¾-in. flange is turned out on the back of the gutter, as shown. To this ¾-in. flange either flat seam, standing seam, batten, composition, tile or slate roofing may be connected by following the details of construction shown on Drawings No. 16 to 24, inclusive.

Gutter Linings in Concrete and Terra Cotta Cornices

Drawing No. 28

The procedure for lining box gutters formed in concrete and terra cotta cornices is illustrated in Drawing No. 28.

Fig. 1 shows a cornice of concrete construction with a reglet *A* molded in the concrete about 1 in. wide and 1½ in. deep. This concrete gutter is made flaring at the sides to avoid broken seams when ice forms in gutter. Sleepers are placed in the concrete roof about 24 in. apart on which the sheathing is nailed.

In lining the gutter, a standing strip is placed in the reglet, projecting over the top of the concrete not less than 1 in. The reglet is filled with molten sulphur and as the sulphur expands when it cools, a tight joint is obtained. The gutter lining is locked to the strip at *B* as shown and turns out at the eaves line of the roof with a ¾-in. edge to which either type of roofing is locked as shown on Drawings No. 16 to 24, inclusive.

When copper is used for gutter lining, the sheets at all cross joints are tinned 1½ in. on both sides before the locks are turned. The locks are cleated and well soldered. Strainers are placed over all openings to avoid stoppage of inside drains. If expansion joints are required, the construction shown in details on Drawing No. 17 are applicable.

Fig. 2 shows the construction details of gutter lining in a terra cotta cornice with flashing to a parapet wall. A cap flashing is built in the wall as the masonry progresses. The flashing enters the wall the width of a brick, as shown, and turns up about 1 or 2 in. as indicated by *F* and turns down on the outside not less than 3 in.

As described in connection with Fig. 1 the standing strip in Fig. 2 is also placed in the reglet and this is filled with molten sulphur. The gutter lining is locked to the strip at *H* and turns up under the cap flashing at *J*.

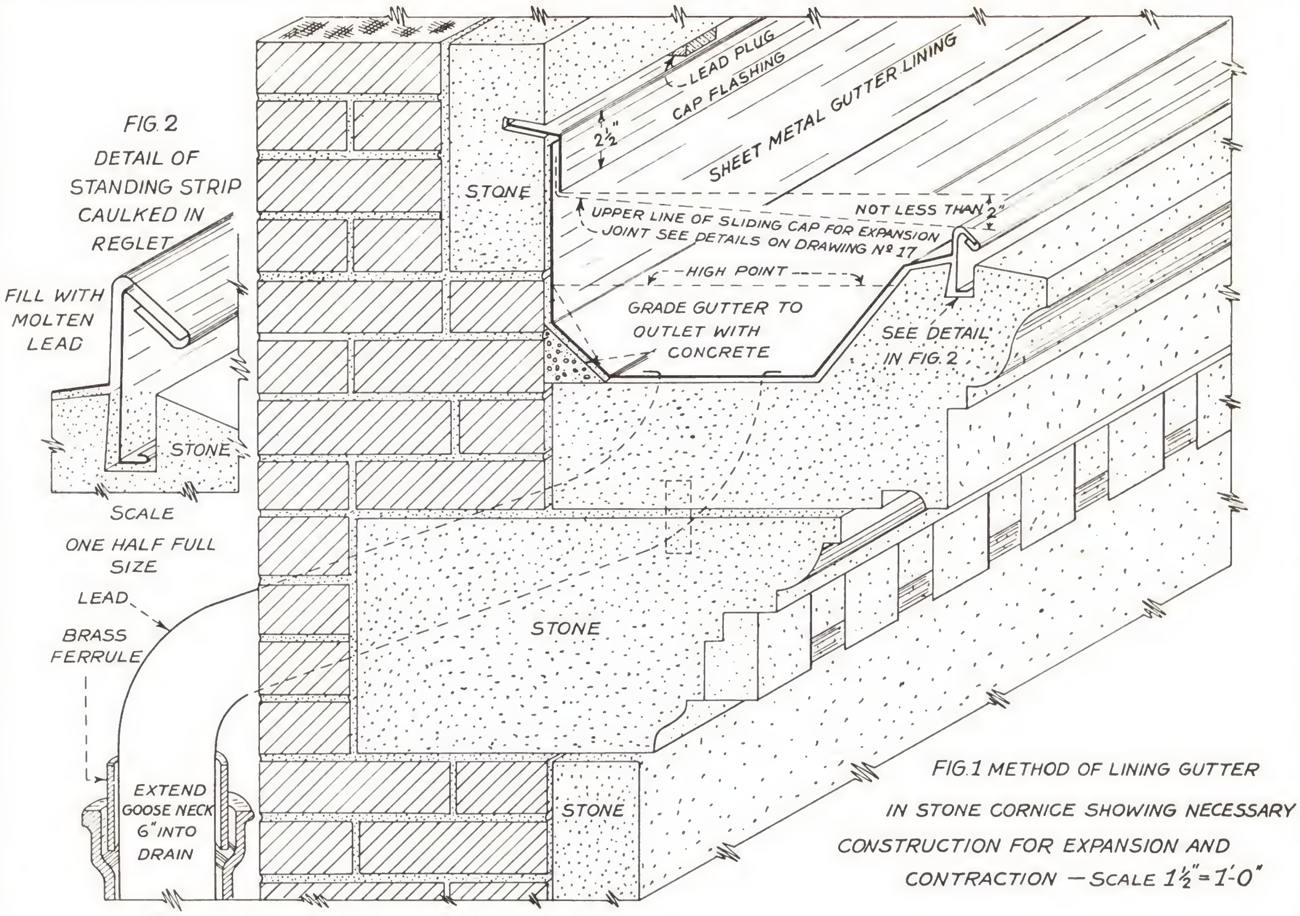


FIG. 1 METHOD OF LINING GUTTER IN STONE CORNICE SHOWING NECESSARY CONSTRUCTION FOR EXPANSION AND CONTRACTION — SCALE 1½"=1'-0"

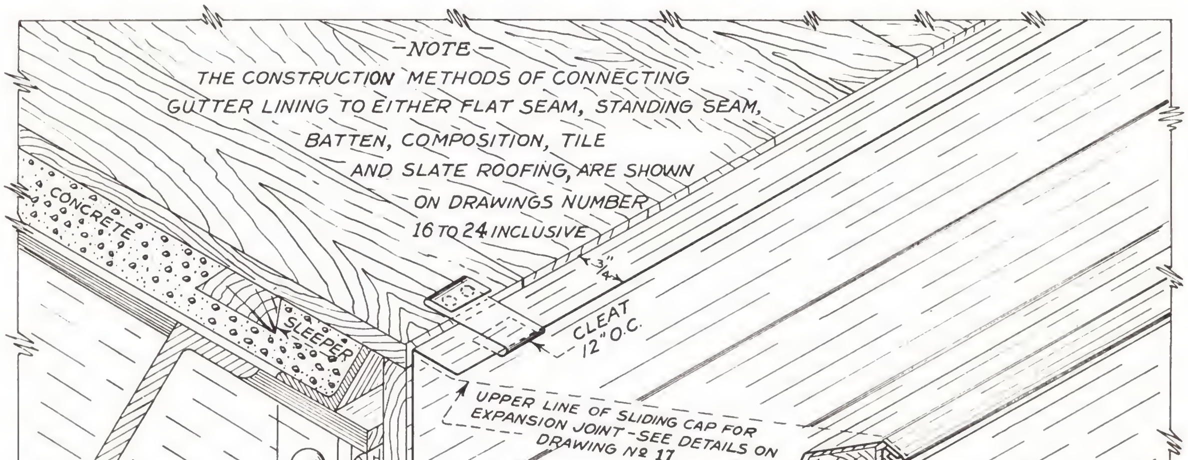


FIG. 3 METHOD OF LINING BOX GUTTER BUILT ON STONE CORNICE — SCALE 1½"=1'-0"

DRAWING NUMBER 27 GUTTER LININGS ON STONE CORNICE

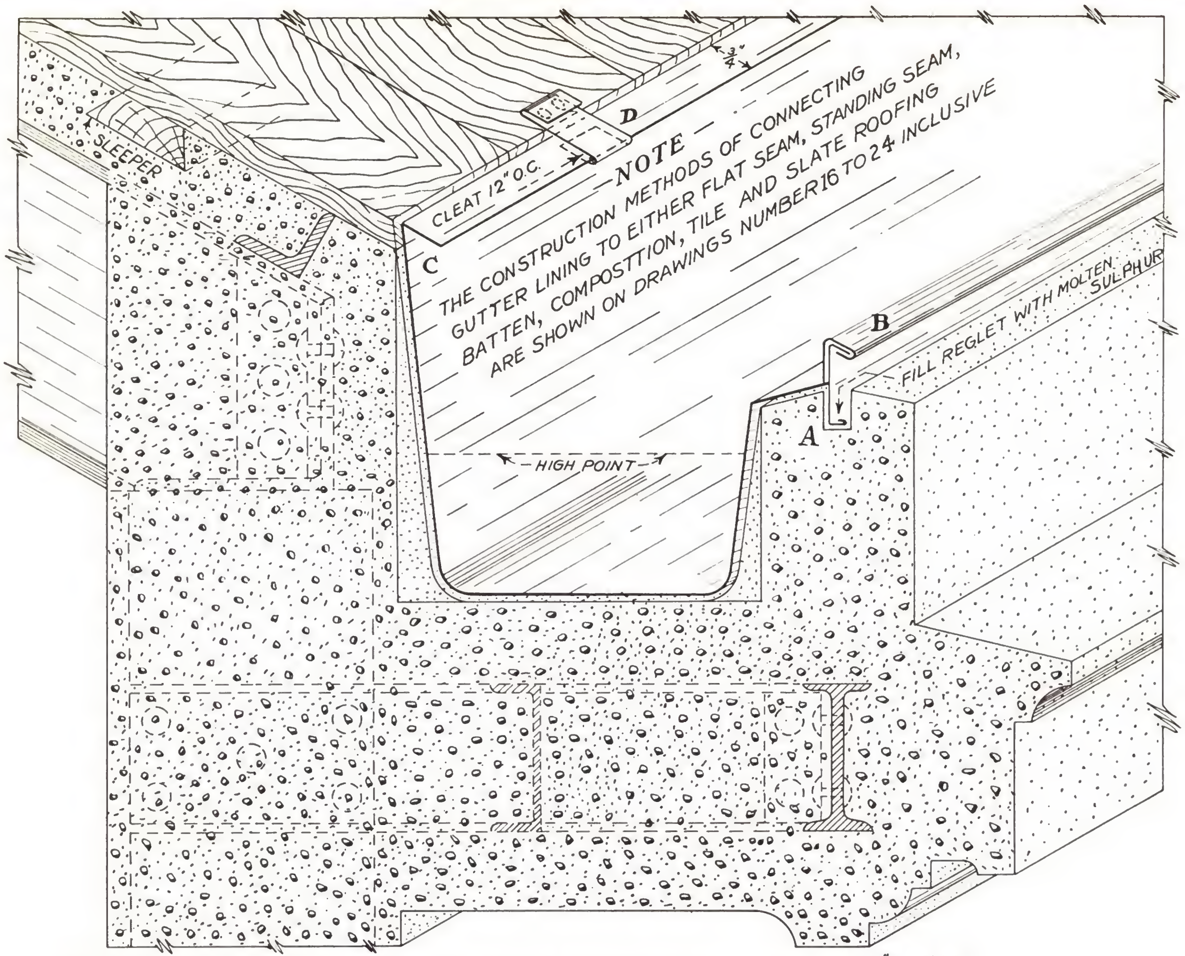
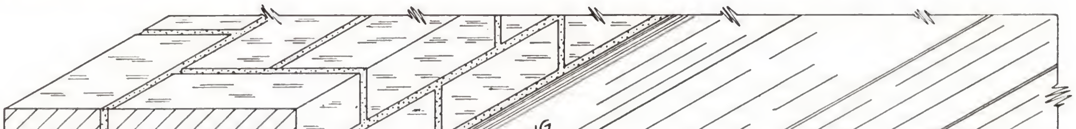


FIG 1 METHOD OF LINING GUTTER IN CONCRETE CONSTRUCTION — SCALE $1\frac{1}{2}" = 1'-0"$



— SCALE $1\frac{1}{2}" = 1'-0"$ —

FIG. 2 METHOD OF LINING GUTTER IN A TERRA COTTA CORNICE

DRAWING NUMBER 28

GUTTER LININGS IN CONCRETE AND TERRA COTTA CORNICES

PROPORTIONING GUTTERS, LEADERS AND OUTLETS

(This Section reprinted, by permission, from "Modern Applications of Sheet Copper in Building Construction," of Copper & Brass Research Association, New York, N. Y.)

The design of a drainage system as far as capacity is concerned depends on the amount of water to be handled. This in turn depends upon the intensity and duration of rainfall in the particular locality.

The roof area used in computations should be the actual area and not the horizontal projection, or plan, of the area. Rain seldom falls vertically, and the maximum condition exists when it strikes perpendicular to the roof plane, making the total area effective.

RAINFALL DATA

As conditions throughout the country vary rainfall data should apply to the locality in which the structure is to be built.

Fig. 128, below, is a table compiled from charts of the U. S. Department of Labor that show the occurrence and duration of rainfall intensities in 23 cities, for which the U. S. Weather Bureau has included data of excessive rainfalls in its annual reports. In most cases these records begin about 1896, but as few storms were recorded and measured in the early years there may be some discrepancies, particularly for the cities west of the Mississippi River. Where absolute safety is necessary this fact should be borne in mind. These records were used unadjusted in compiling the table.

The type of structure for which the drainage system is being designed must also be considered. A storm of maximum intensity may occur only once in twenty years

	A Storms which should be exceeded only once in 5 years		B Storms which should be exceeded only once in 10 years		C Maximum record Storms	
	Intensity in Ins./Hr. lasting 5 minutes	Sq. Ft. of actual roof drained per Sq. In. of Leader area	Intensity in Ins./Hr. lasting 5 minutes	Sq. Ft. of actual roof drained per Sq. In. of Leader area	Intensity in Ins./Hr. lasting 5 minutes	Sq. Ft. of actual roof drained per Sq. In. of Leader area
Albany, N. Y.	6	200	7	175	7	175
Atlanta, Ga.	7	175	7	175	9	130
Boston, Mass.	5	240	6	200	7	175
Buffalo, N. Y.	5	240	5	240	10	120
Chicago, Ill.	6	200	7	175	7	175
Detroit, Mich.	6	200	6	200	7	175
Duluth, Minn.	5	240	6	200	7	175
Kansas City, Mo.	7	175	8	150	10	120
Knoxville, Tenn.	5	240	6	200	6	200
Louisville, Ky.	6	200	7	175	8	150
Memphis, Tenn.	5	240	6	200	10	120
Montgomery, Ala.	7	175	7	175	7	175
New Orleans, La.	7	175	7	175	8	150
New York City, N. Y.	6	200	8	150	9	130
Norfolk, Va.	6	200	7	175	8	150
Philadelphia, Pa.	6	200	7	175	8	150
Pittsburgh, Pa.	6	200	6	200	7	175
St. Louis, Mo.	6	200	8	150	11	110
St. Paul, Minn.	6	200	6	200	8	150
San Francisco, Cal.	2	600	2	600	3	400
Savannah, Ga.	6	200	7	175	8	150
Seattle, Wash.	2	600	2	600	2	600
Washington, D. C.	6	200	7	175	8	150

Fig. 128—Rainfall Data and Drainage Factors

in a certain locality, while a lower rainfall intensity will be exceeded only once in ten years. If gutter overflow is a matter of inconvenience only, or if the design can incorporate auxiliary drains to care for the excess, the lower intensity may well be used. In residential construction, for instance, no great harm need result if water spills out of gutters during one storm in five years, and the use of the corresponding intensity of rainfall rather than one that will never be exceeded can effect considerable saving.

On the other hand, the architect who is designing a monumental building—where the construction of built-in gutters with cornices, parapets, etc., is such that an overflow would have most serious consequences—can design only for maximum conditions.

LEADER DESIGN

In the design of leaders, practical considerations apply as well as principles of hydraulics. In a given time more water will drop through a vertical pipe than will flow in a horizontal trough of equal area. Therefore it appears that the leader could well be much smaller than the gutter and still take care of all the water coming to it; moreover, it might seem that the leader could be tapered as the velocity of the falling water increases with the fall.

These inferences would follow if only pure hydraulics were involved, but experience has shown that, due to practical considerations, such as frequent plugging by debris, or collapse because of the vacuum created in long drops when a plugged outlet is suddenly cleaned, the following rules must be followed:

(1)—4″ round, square, or rectangular leaders are the minimum (except for small porches);

(2)—The leader area is constant throughout its length;

(3)—Long leader drops are constructed with leader heads every 40 ft., to admit air and prevent vacuums;

(4)—Maximum spacing of leaders must not exceed 75 feet.

With item (4) in mind, the locations of the leaders are first determined. If possible, they should be placed near the corners of the building so that the gutter water will not have to flow far beyond a sharp turn. Building expansion joints, because they necessarily are located at high points in the gutter, will often govern leader location. Of course, appearance and other architectural considerations will also play a part.

With the locations determined, the areas tributary to each leader should be computed. Actual roof areas should be used, not plan areas. These areas are then divided by the proper factor taken from the table in **Fig. 128** and the required areas in square inches of the leaders are thus determined. Then from the table in **Fig. 129** the right-sized leaders are selected.

Fig. 128 gives the intensity of rainfall that can be expected in 23 cities according to U. S. Weather Bureau records, and the corresponding amounts of roof area that one square inch of leader area will drain during such storms. The latter are based on the assumption that for an intensity of 8″ per hour, one sq. in. of leader will care for 150 sq. ft. of roof. The table is set up on three different bases. Column "A" is for conditions that may be exceeded on the average of once in five years; Column "B" for rainfalls that may be exceeded once in ten years; and Column "C" gives the maximum rainfalls yet recorded. Which column should be used in any given instance is a question of judgment for the designer.

Type	Area in Sq. In.	Nominal Leader Sizes
Plain Round	7.07	3″
	12.57	4″
	19.63	5″
	28.27	6″
Corrugated Round	5.94	3″
	11.04	4″
	17.72	5″
	25.97	6″
Polygon Octagonal	6.36	3″
	11.30	4″
	17.65	5″
	25.40	6″
Square Corrugated	3.80	1¾″ x 2¼″ (2″)
	7.73	2⅜″ x 3¼″ (3″)
	11.70	2¾″ x 4¼″ (4″)
	18.75	3¾″ x 5″ (5″)
Plain Rectangular	3.94	1¾″ x 2¼″
	6.00	2″ x 3″
	8.00	2″ x 4″
	12.00	3″ x 4″
	20.00	4″ x 5″
	24.00	4″ x 6″
S.P.S. Pipe	7.38	3″
	12.72	4″
	20.00	5″
	28.88	6″
Cast Iron Pipe	7.07	3″
	12.57	4″
	19.64	5″
	28.27	6″

Fig. 129. Dimensions of Standard Leaders

Example:

Suppose the problem is to design the leaders for a building in Boston which is to be 120 ft. by 80 ft. with a plain gable roof having a ridge down the center and a slope of

9″ to the foot. Assume further that there will be a leader at each corner and that it seems proper to allow for one overflow in ten years.

Solution:

If the slope is 9″ per ft., the roof area on each side of the ridge is 120′ by 50′, or 6000 sq. ft., and each leader would serve 3000 sq. ft.

From Column "B" of **Fig. 128,** opposite Boston, it is found that 200 sq. ft. is the amount of roof area which 1 sq. in. of leader will serve, and accordingly a leader having an area of 15 sq. ins. is required.

By turning to **Fig. 129,** which lists the areas and dimensions of standard leaders, it is found that 5″ round or octagonal leaders are required, or that either 3¾″ x 5″ square corrugated or 4″ x 5″ plain rectangular leaders could be used.

GUTTER DESIGN

SMALL RESIDENCE WORK

As in the case with leader design, judgment plays a large part in the design of gutters. The type of structure has an important bearing. Where occasional overflow of the gutters is not a serious matter, experience has proven certain arbitrary rules entirely adequate. These are based partly on the size of the leaders, determined as outlined above.

The best type of gutter has its minimum depth equal to half and its maximum depth not exceeding three-quarters of its width. Thus width becomes the deciding factor in proportioning size. There is no reason for a gutter deeper than three-quarters of its width except for ornamental purposes, and for practical reasons it is distinctly desirable to keep the gutter shallow. Assuming that the ratio of depth to width is kept within these limits, the gutter can be referred to by width only.

The size of gutters depends upon:

(1) The number, size, and spacing of the outlets.

The gutter acts as a receiving channel to carry the water to the outlet. The slope of the gutter determines the flow toward the outlets.

(2) The slope of the roof.

A steep roof carries the water to the gutter faster than a flat one does.

(3) The style of gutter used.

Some gutters are not effective for their full depth and width. In proportioning gutters consideration of the available area is essential.

(4) A gutter less than 4″ wide is to be avoided.

In ordinary practice 4″ gutters are seldom used for they are difficult to solder and increase the labor cost. The gutter may be the same size as the leader it serves, but, of course, can not be smaller.

(5) Half-round gutters are economical and properly proportioned.

This type uses a minimum of material and insures a proper ratio of width to depth.

(6) A minimum slope of 1/16 of an inch per foot is required.

Less than this will not provide for proper flow of water in the gutter.

Based on the above, safe rules for determining the size of gutters for ordinary work are:

(1) If spacing of leaders is 20′ or less, use a gutter the same size as the leader, but not less than 4″.

(2) If spacing of leaders is more than 20′, add 1″ to the leader diameter for every 30′ (or fraction) additional spacing on peaked roofs, and add 1″ for every additional 40′ of gutter length for flat roofs.

Examples:

1. A 40′ gutter serves a 4″ leader on a flat roof. The gutter should be 5″.

2. A 75′ gutter serves a 4″ leader on a peaked roof. The gutter width is 6″.

3. A 75′ gutter serves a 4″ leader on a flat roof. The gutter width is 6″.

LARGE AND MONUMENTAL BUILDINGS

Gutter and leader installations in large buildings require liberal design to insure against any possibility of gutter overflow. Design and use requirements of monumental structures are often such that a single overflow will have most serious consequences.

For such designs the following formulae (or the charts based on them) are recommended. These are derived empirically from tests carried out on level gutters at the U. S. Bureau of Standards in Washington. By using them liberal sizes are obtained that are ample for important work. These formulae are:

For **Semicircular Gutters:** $W = 1.3\, Q^{2/5}$

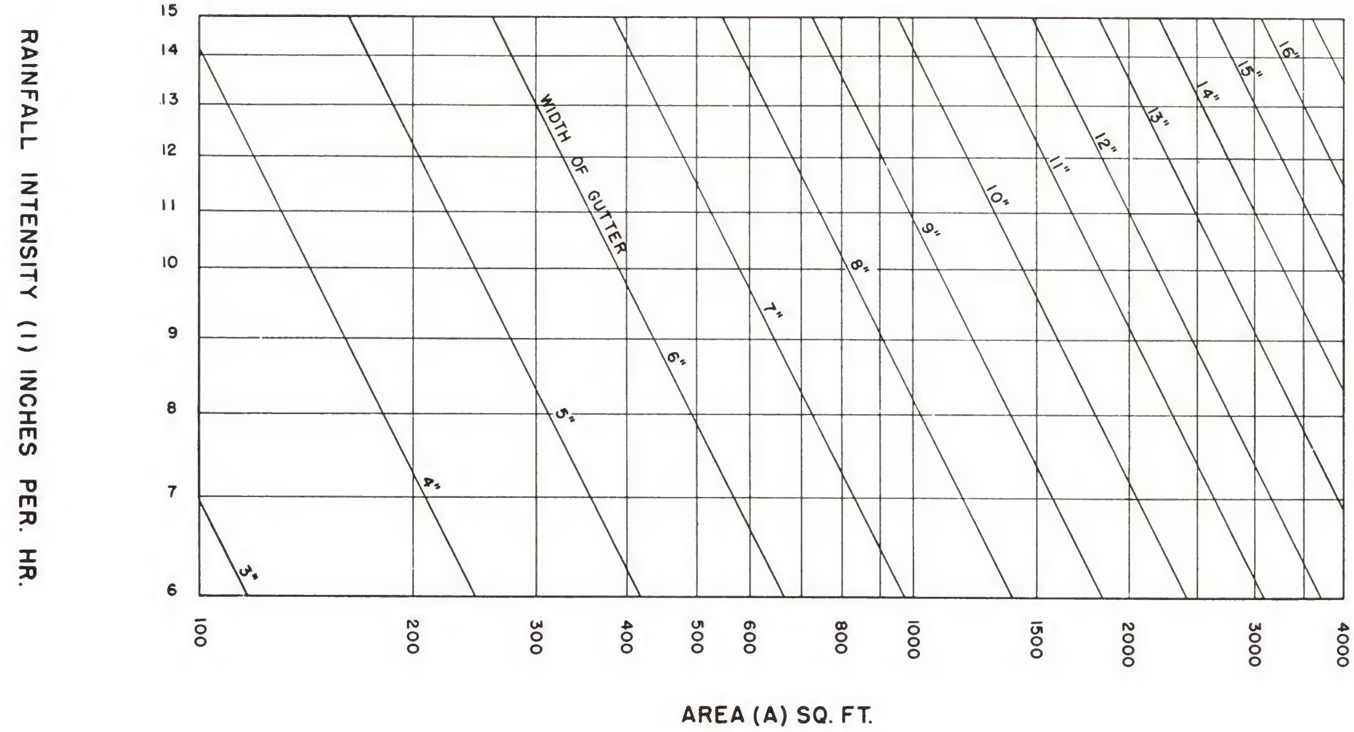
For **Rectangular Gutters:** $W = 0.481\, m^{-4/7}\, l^{3/28}\, Q^{5/14}$

where, W = width of gutter in feet

m = depth/width

l = length of gutter in feet

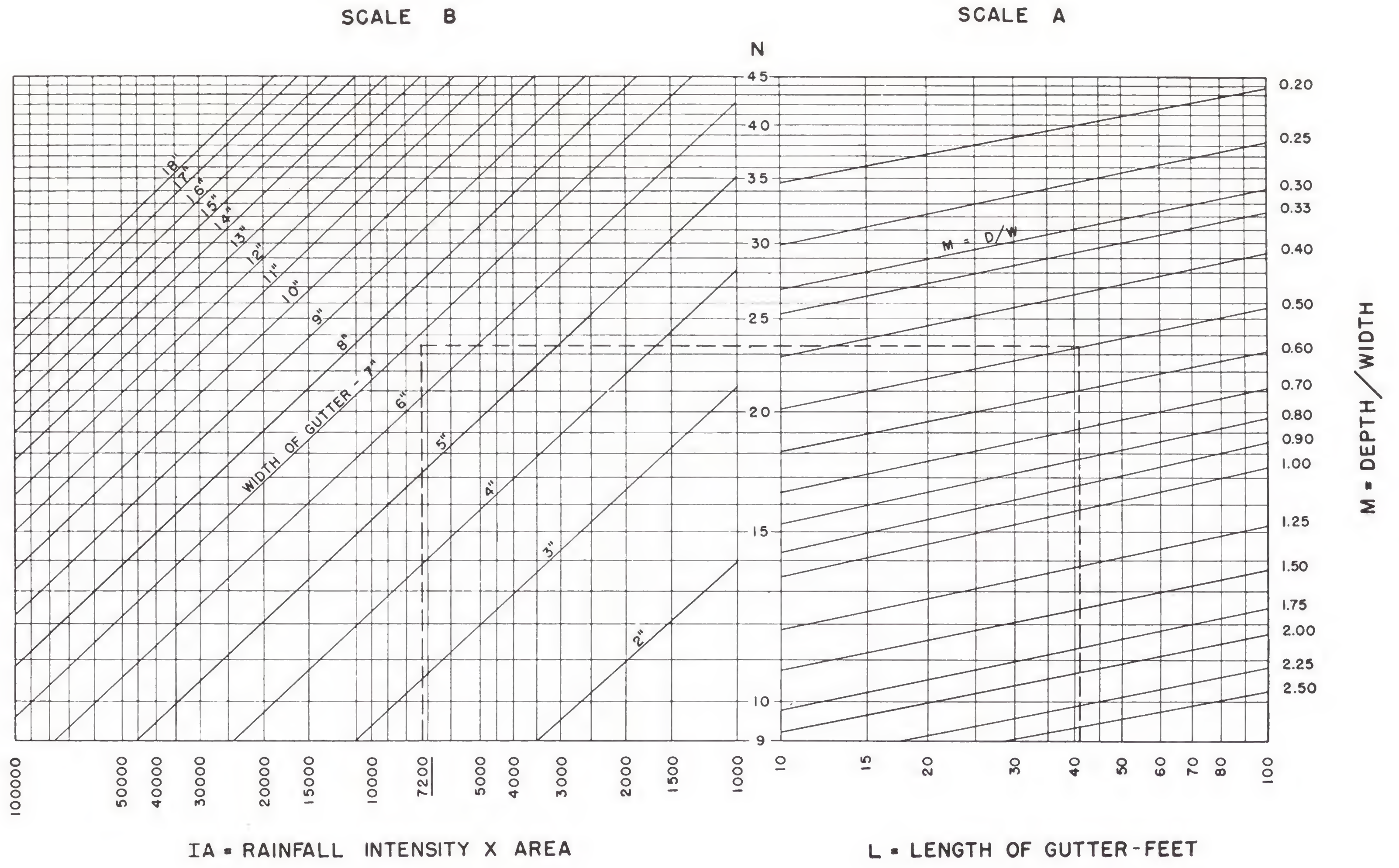
Q = total gutter inflow (cu. ft. sec.)



SEMI CIRCULAR GUTTERS

WIDTH OF GUTTER FOR GIVEN ROOF AREAS AND RAINFALL INTENSITIES

FIG. 130



RECTANGULAR GUTTERS
WIDTH OF GUTTER FOR GIVEN ROOF
AREAS AND RAINFALL INTENSITIES

FIG. 131

The charts on **Figs. 130** and **131** have been plotted from these formulae so that Gutter Widths may be read directly in Inches in terms of Rainfall Intensities and tributary Roof Areas. They are for level gutters. Where the slope exceeds 2% the gutter should be narrowed and deepened to reduce the cavitating action of wave crests that reduces velocities on wide, smooth slopes steeper than 1 on 50.

Example 1: (Semicircular)

A semicircular gutter is required to drain a roof 20′ x 40′, located in Buffalo.

Solution:

In **Fig. 128,** third column, the Maximum Rainfall Intensity, I, of 10″ per hour is given for Buffalo. The roof Area, A, is 800 sq. ft. On the graph of **Fig. 130** find 800 on the bottom scale, pass vertically to the horizontal line representing an I of 10″ per hour. The intersection falls nearly on the line marked 8″ which, accordingly, is the width of the gutter required. If the intersection falls between two sizes, the larger one should, of course, be used.

Example 2: (Rectangular)

A roof area 40′ long by 20′ wide is to be drained by a rectangular level gutter, the depth of the gutter being half of the width. The building is located in Atlanta.

Solution:

From the third column of **Fig. 128** the Maximum Rainfall Intensity, I, for Atlanta is taken at 9″ per hour. From the proportions of the gutter, $m = 0.5$. The length of gutter, is l, is 40′, and the area drained by it, A, is 800 sq. ft. Thence IA = 7,200.

On the chart "Rectangular Gutters," **Fig. 131,** find the vertical line representing $l = 40$. Proceed vertically along this to its intersection with the oblique line representing $m = 0.5$. Thence pass to the left through N = 23.3 (an equalizing Constant) to intersect the vertical line representing IA = 7,200. The point of intersection occurs between the oblique lines representing gutter widths of 6″ and 7″. The required width of gutter is, therefore, 7″ and its depth need be only 3½″.

The required sizes of level gutters of other than semicircular or rectangular shapes can be determined closely by finding the semicircle or rectangle of the same area that most closely fits the irregular cross-section. This is done by drawing the required shape to any convenient scale and making the fit graphically so that the areas of excess and shortage will be equal. A trapezoidal shape of depth equal to one-half the width is closely fitted by a semicircle. A molded gutter can usually be approximated by a rectangle. This method was checked experimentally in laboratory tests, and the discrepancies found to be very small.

Reference

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Copper and Common Sense

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Simplified Practice Recommendation R29-49
U. S. Department of Commerce

Blue Book 1949

South Florida Roofing & Sheet Metal Contractors Association

Master Specifications for Copper Roofing and Sheet Metal Work in Building Construction

Revere Copper and Brass Incorporated

FLASHINGS

SHEET METAL CONTRACTORS' NATIONAL ASSOCIATION, INC.

107 CENTER STREET • ELGIN, ILLINOIS

A National Organization to Improve, Extend and Protect the Uses of Sheet Metal in Ventilating and Air Conditioning, Warm Air Heating, Industrial Air Handling, Architectural Sheet Metal, Roofing.

AIA File No. 12-H

SHEET METAL CONTRACTORS' NATIONAL ASSOCIATION, INC.
107 CENTER STREET • ELGIN, ILLINOIS

FOREWORD

In 1929, the National Association of Sheet Metal Contractors (dissolved in 1933) published "Standard Practice in Sheet Metal Work," a 750 page reference book of standards of practice in fabricating and erecting sheet metal work.

Several years of exhaustive research and study, by scores of men comprising the sub-committee which prepared Sections covering particular phases of sheet metal construction, preceded the actual publication.

Much of the construction shown in Standard Practice in Sheet Metal Work was, at the time of its publication, original material — not to be found in other published literature of the industry. Many of the constructions shown had their origin in the very old craftsmanship brought to this country by the sheet metal artisans who came to America in the last century.

To this basic heritage was added the new materials and new techniques of the first quarter of the twentieth century.

The men who prepared Standard Practice in Sheet Metal Work created even beyond their vision. While the industry has advanced notably in the years since publication of this book, basically most of the constructions shown in Standard Practice in Sheet Metal Work are, today, as applicable as they were in 1929.

Standard Practice in Sheet Metal Work was widely distributed among the architects of the 1930's. But in the 1930's, through a series of circumstances, plates, unbound pages, drawings, manuscripts passed out of existence.

Today, despite the greatly enlarged literature of the industry, there is a growing demand for copies of Standard Practice in Sheet Metal Work. To meet this demand, the Architectural Sheet Metal Manuals Committee of the Sheet Metal Contractors' National Association, Inc., has undertaken the publication of a series of Manuals to replace the former book. Each Manual will deal with one of the major phases of present day sheet metal construction.

These Manuals make use of a large part of the text and drawings from Standard Practice in Sheet Metal Work. Where necessary, original text and drawings will be supplemented by information which accommodates the new materials and new techniques which have become acceptable since 1929.

The Sheet Metal Contractors' National Association has been given permission to use material from Standard Practice in Sheet Metal Work by the heirs of the estate of George Harms, the General Chairman of the Trade Development Committee of the former association. This permission is sincerely appreciated.

SHEET METAL CONTRACTORS' NATIONAL ASSOCIATION, INC.
Architectural Sheet Metal Manuals Committee

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ACKNOWLEDGMENT

This Manual of construction for sheet metal work is made possible only because of the foresight and immeasurable labors of the members and section chairmen of the Trade Development Committee of the former National Association of Sheet Metal Contractors and the guiding spirit of these farsighted committeemen—the General Chairman—George Harms of Peoria, Illinois.

Through his untiring efforts, Standard Practice in Sheet Metal Work developed from a dream of the industry into a reference guide of proper construction for sheet metal contractors and the architects and engineers who design and specify sheet metal work.

Through his willingness to contribute financially, far beyond his just share, Standard Practice in Sheet Metal Work was printed and is recognized as one of the monumental books of the construction industry.

So that these services which George Harms gave so generously to this industry may be for all time perpetuated in the minds of his fellow sheet metal contractors and those who buy our services, the Sheet Metal Contractors' National Association, Inc., hereby dedicates this Manual to the memory of the man who wrought so well to establish the sheet metal industry on a high plane —

GEORGE HARMS

1860—1945

Contents

Why Through-Wall Flashings

Older types of wall construction, embodying thick masonry walls did not have and did not need through-wall flashing.

But present day construction, using structural steel and comparatively thin exterior walls, unless protected with flashings, permit wind driven rain to penetrate the thin walls. Moisture also enters such thin walls through the masonry joints and forms pockets of water which, eventually, may work itself into the interior of the building, by capillary action.

Also, today's thin exterior walls, even though the materials themselves may be waterproof, cannot be considered permanently impervious to wind-driven water. The gradual shrinkage of some materials and the natural movement of buildings, may eventually lead to leaks.

It is, therefore, desirable to have permanent water barriers at all places where rain water and moisture entering the exterior wall can work its way through to the inside, or can come in contact with the wood or steel members of the wall.

This penetration of water through walls is one of the principle problems of modern structural design. Through-wall flashings, of permanent metal, is today considered the most satisfactory method of permanently preventing leaks.

Today's metal through-wall flashings are available in several metals of which copper is perhaps the most common material.

Through-wall flashings are available in many forms — deformed by ridged, ribbed, embossed patterns. The purpose of the deformation is to provide depressions in the sheets for mortar bond and to form keys in all directions. Such deformed sheets are also stiffer than plain flat sheets and require no soldering. The ends of the sheets or sections lock and hook together to form watertight joints and the deformities take care of expansion and contraction.

Experience has shown that such deformed through-wall flashings form a positive mechanical bond that fails only when the mortar shears. Plain flashings lack such bonding qualities and a smooth surface prevents a bond and weakens the wall.

In general, there are two basic types of through-wall flashings — (1) Flashings which go through and extend beyond the wall and (2) flashings which are entirely concealed within the wall.

Today's practice is to specify through-wall flashing—under all copings; at the bases of all parapets and walls that adjoin or penetrate roofs; side walls at all floor levels; at all openings in the wall.

More specifically, through wall flashings are installed at the following locations in exterior masonry walls—under masonry copings; over roof base flashings; over spandrel beams and other horizontal steel members in walls; under masonry chimney caps; over reinforced concrete beams in walls; between the top of concrete foundation walls and the bottom of masonry building walls; over cornices; over projecting belt courses; under belt courses which do not project beyond the face of the wall; under belt courses where the wall thickness is reduced; over doors, windows and openings; under sills; over and under ornamentation built into walls.

The three Figures which follow—Fig.A, Fig. B, Fig. C, illustrate these locations in exterior walls where leaks are likely to occur and a permanent water barrier—through wall flashing—is needed. The 32 details which make up these three Figures are not explained in detail because such explanation is not necessary and the Figures are intended to demonstrate where and how through-wall flashings are used.

Figures A, B, C, are reproduced from the Manual "Sheet Copper," Copper and Brass Research Association, New York, N. Y.

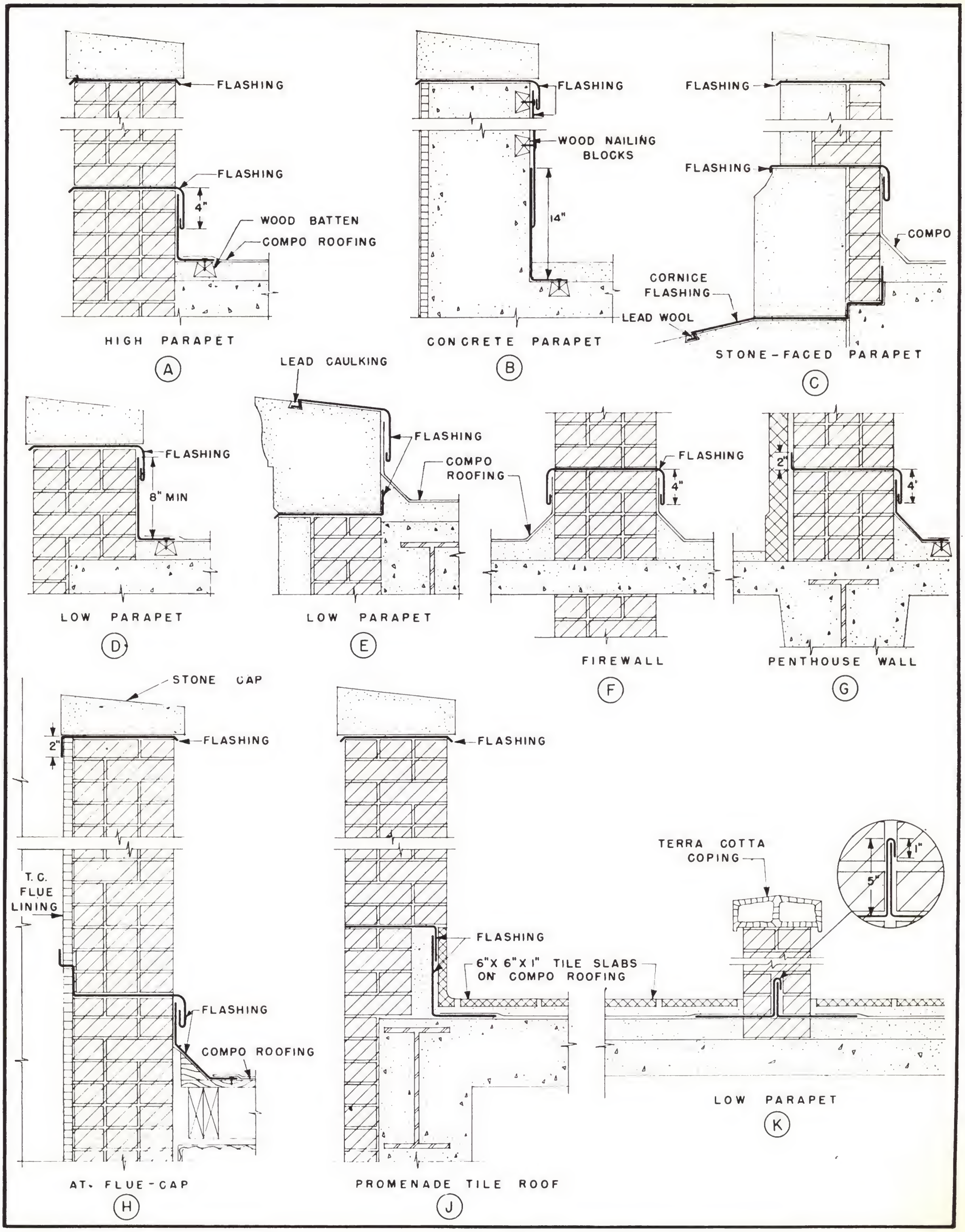


FIG. A WALLS & PARAPETS

COPPER AND BRASS RESEARCH ASSOCIATION

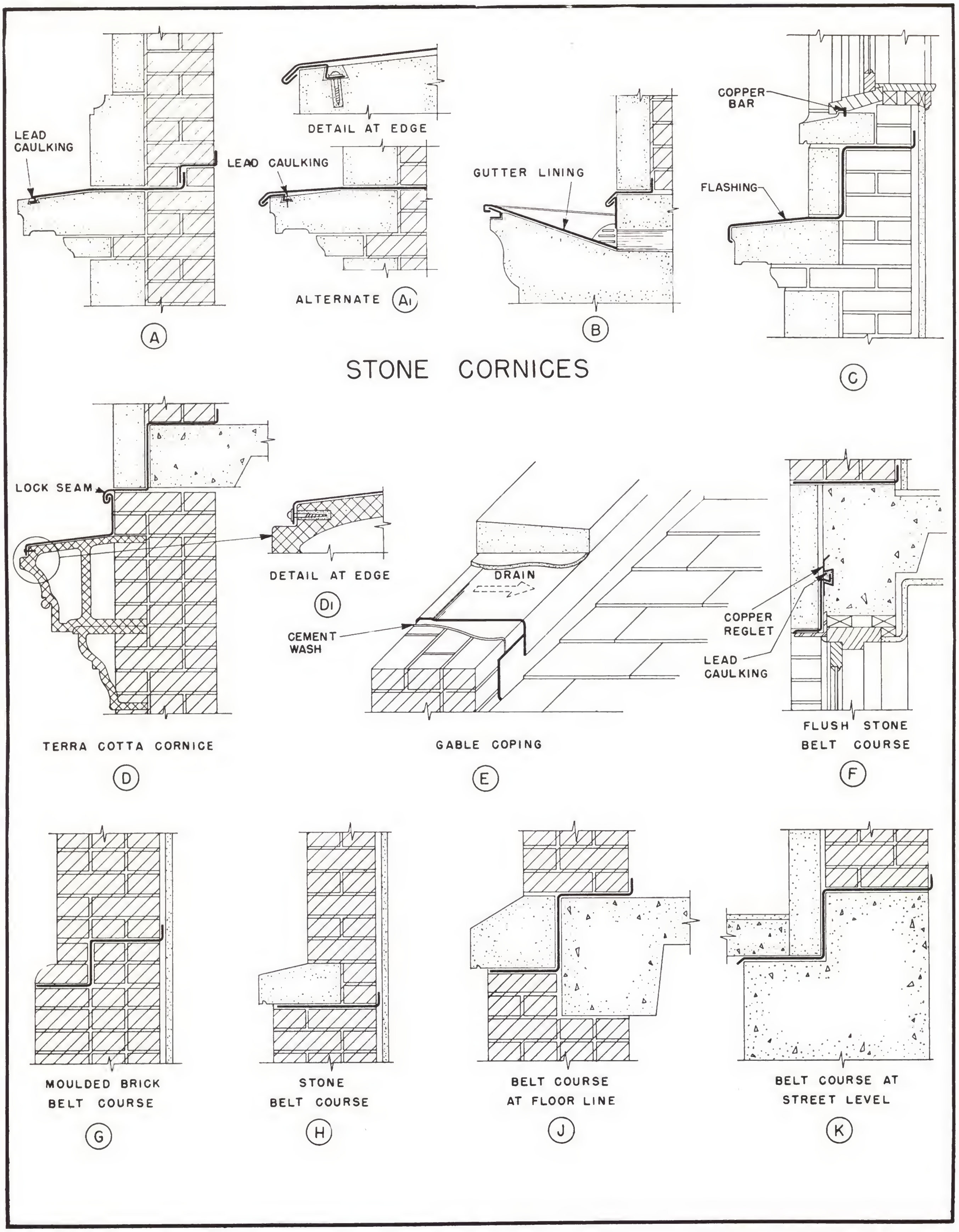


FIG. B CORNICES & BELT COURSES

COPPER AND BRASS RESEARCH ASSOCIATION

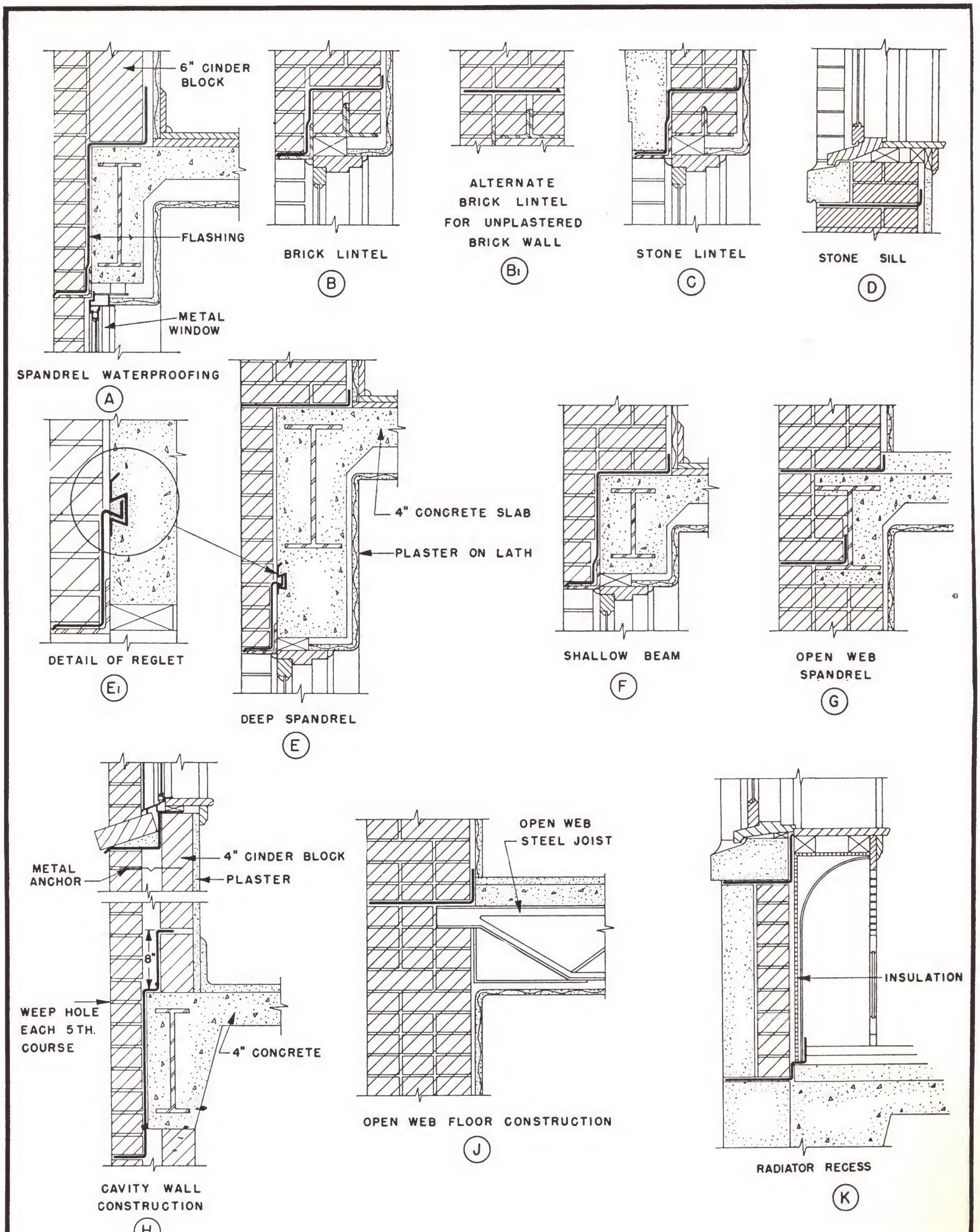


FIG. C WINDOWS & SPANDRELS

COPPER AND BRASS RESEARCH ASSOCIATION

Expansion and Contraction

The necessity for providing for linear expansion and contraction movement in all metals used for flashings or metal construction is well understood.

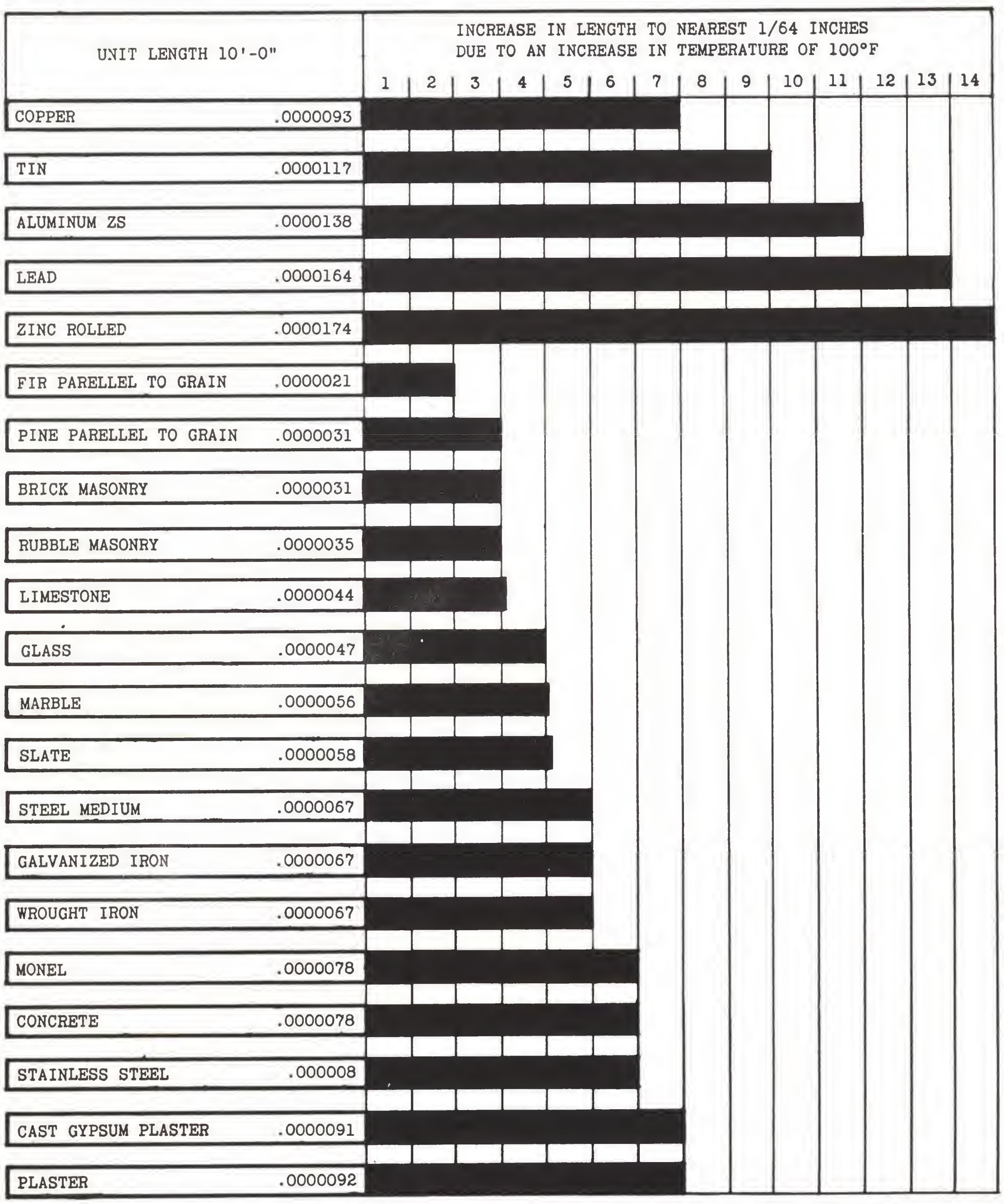
The question is how much provision must be made according to the expected highest and lowest local temperatures and according to the temperatures at the time of installation.

Some building metals expand more than others. The Table-Chart reproduced following, submitted by the Research and Development Department of Revere Copper and Brass Incorporated, shows expansion in terms of 1/64 inch increments for an increase in temperature of 100 Deg. F. for a 10-foot length of material.

The Table-Chart shows that copper will have more movement than iron, steel or Monel metal, and less than aluminum, lead or zinc.

Temperature conditions at the time of installation must be considered. Metal laid in hot weather needs little space for expansion, but does require provision for contraction. The reverse is true for work done in cold or cool weather.

Also of interest is information from the Bureau of Standards, Washington, D.C. on the National Museum copper roof tests covering a period of about one year. Simultaneous air temperatures were also recorded. This information comes from the manual "Sheet Copper" of Copper and Brass Research Association.



These tests showed that during the night roof and metal temperatures remain quite uniform. The minimum temperature was reached at 5 o'clock in the morning. While the sun was down, the roof metal temperatures ran slightly less than the air temperature. This was due to radiation of heat from the metal to the air. This under-cooling ran from 10 Deg. to 16 Deg.

When the sun came up, the metal temperature rose sharply. The effect of clouds was marked even though the air temperature remained stable. The difference between metal and air temperatures, when the sun was shining was large.

On rainy days, or when the sun was obscured by heavy clouds, the effect was similar to night conditions.

An idea of typical recordings in the Bureau tests showed—

Max. Roof Temp. (Washington)..	147 Deg.
Corresponding air Temp................	103 Deg.
Min. Roof Temp. (Washington)..	10 Deg.
Corresponding air Temp...............	11 Deg.
Max. Rate of Change in 6 hrs.....	0.2 Deg. per Min.
Max. Rate of Change in 30 Min....	1.5 Deg. per Min.
Max. Av. Daily Range................	63 Deg.

These tests were on a roof with a patina. New copper would have a lower coefficient of absorption and a higher coefficient of reflection and so will show a lower range of temperatures.

Under exceptional circumstances, a copper roof may reach a temperature of 180 Deg. Over much of the United States probably 150 Deg. will rarely be exceeded.

The forces of expansion and contraction are tremendous. Concrete pavements shattered by heat are proof of this statement. A copper sheet laid at 90 Deg. and fastened to prevent any movement will, through a temperature range of from 20 Deg. below to 150 Deg. above zero set up stresses approximating 28,000 pounds per square inch.

To insure unrestricted movement of metal laid as covering, it is suggested that the saturated asphalt paper commonly used under metal should be separated from the metal by a smooth building paper so that the asphalt will not "bleed" under heat and "bind" the metal.

This explanation of expansion and contraction points up the importance of sufficient "Expansion Joints," "End Joints" and all mechanical methods for joining sections together, described in other sections of this Manual.

Expansion Joints

Some means is often required to provide for expansion and contraction of the structure—particularly in long buildings. After the provision has been made in the building itself, the open joint must be protected from water by a protective caping of permanent metal.

This calls for expansion joints.

The several details and explanation following, illustrate and describe a number of expansion joints which experience has shown to be practicable and protective.

Detail 1 shows two variations of a simple Accordian Fold Expansion Joint. Along the roof, the endwise or end joints should be locked and soldered, except the expansion joints, occuring generally not over forty feet apart, which should be of the flat type with return bends and a loose locking cover. The several pieces of the vertical expansion joint only need to be weather lapped about two inches and fastened to the construction at the top edge to hold them in place.

Detail 2 shows an Accordian Fold Expansion Joint in a brick wall and in a roof, composed of copper annealed with a torch to minimize cracking due to work hardening. As an added precaution against leaks, a cover piece is applied over these vulnerable bends at the changes of direction. This type of expansion joint, of the size shown, should not be farther apart than 100 feet.

Detail 3 shows a Double Tongue and Sheath Expansion Joint in a brick wall and in a roof. This type of expansion joint accomodates dimensional changes in every direction and does not create fatigue stresses in the joint metal. Changes in direction are simply made by using miter or bevel joints.

Details 1, 2, and 3 were developed in the office of Albert Kahn and Associates, Detroit, Michigan and submitted by The American Brass Company.

Detail 4 shows an expansion joint suitable for metal roofing at a building setback. The coping cover and counter flashing on the parapet wall should have free-sliding edges as shown in the subdetail. The inner edge should be formed with loose single lock to the base flashing with a turn-back on the upstanding leg of the base flashing at least 1/4 inch greater than that of the counter flashing or coping cover. The expansion joint is built over a wood or other curb, as high as required for the area, and can be constructed as shown.

Detail 4 has been submitted by Henry E. Voegeli, Development Engineer, The American Brass Company.

Detail 5 shows an Expansion Joint at roof employing a cover which forms a weather-tight protection. Curbs at least 8 inches high are formed in the roof on both sides of the expansion space with curbs sloped to give the cover a minimum pitch of 2 inches per foot. Anchored wood plates for nailing are required.

The edge strips shown act as a cap flashing and are formed with projecting edges over which the standing seam cover is locked. The edge strip should be made from sheets not greater than 8 feet in length. They should be secured to the tops of the curbs with brass screws spaced not more than 6 inches apart.

To close the expansion space which is a vertical slot in the face of the wall, a V expansion piece is built into the masonry as shown in Section A-A of Detail 5. This expansion piece is made of 16 oz. cold rolled copper in suitable lengths and each piece is lapped over the next not less than 2 inches.

Detail 6 shows additional constructions. The parapet coping cap is protected as Shown in Section E-E where formed strips are held in place by caulked reglets with a cap sheet locked as shown. Note one edge provides for movement.

Section D-D shows the protection on the inside vertical face of the parapet. The locking strips are built into the masonry. The cap strip is locked as shown with one lock providing for movement.

The standing seams used in the cover over the roof expansion space are spaced as shown in Detail B-B. A 3-in. copper cleat secured to the wood plate with two brass screws is locked into each seam. These cleats are placed in the high side only, thus securing the cover to that side and allowing movement to take place on the lower side. The standing seam cover is hooked over the edge strip on the higher curb in a 1-in. lock. On the lower curb, the cover is locked over the edge strip with a total projection two times the width of the expansion space E plus 1 inch as shown in Section B-B.

To facilitate erection, it is suggested that the preformed expansion joint cover on the parapet wall be made in two pieces and soldered together after installation. Where the expansion joint cover is bent at right angles, the locks should be slit, and

after bending, a separate angle piece of copper soldered over the slit as shown in Section B-B.

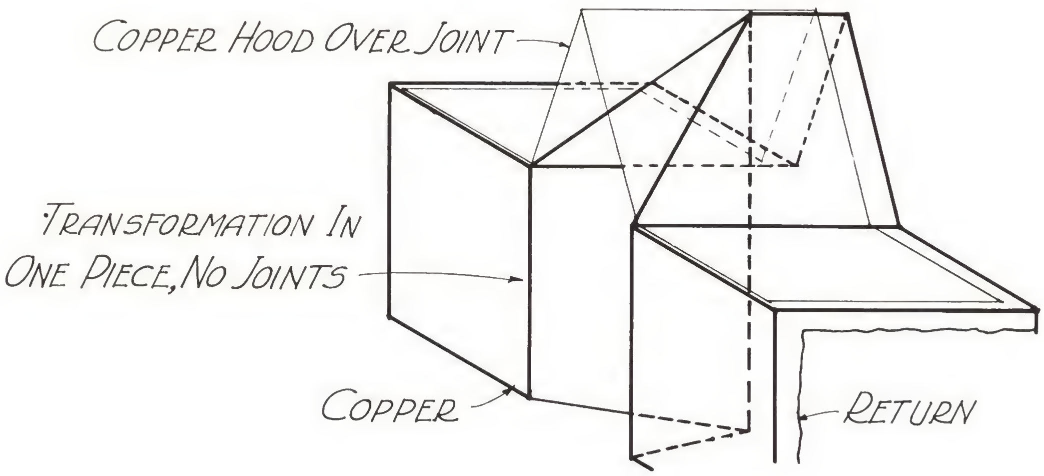
For low parapets, the curbs in the roof on both sides of the expansion space should be the height of the parapet. The locking strips in the coping stone are secured into a reglet as shown in Section E-E and continue out past the inside space of the parapet wall to lap the edge strip on the curbs at least 3 inches.

Detail 7 shows the installation of water stop units in expansion joints at corners and in straight walls of masonry construction. Units are formed in 8-ft. lengths and should run continuously from the footing to the eave or top of the parapet. Above grade the end joints should be soldered. Each flange on the unit should be built into the masonry joints not less than 4 inches. Premolded fillers or strips of compressible filler are used in place of mortar in the through joints. The mortar joint parallel to the direction of movement in the wall is broken with strips of saturated roofing felt.

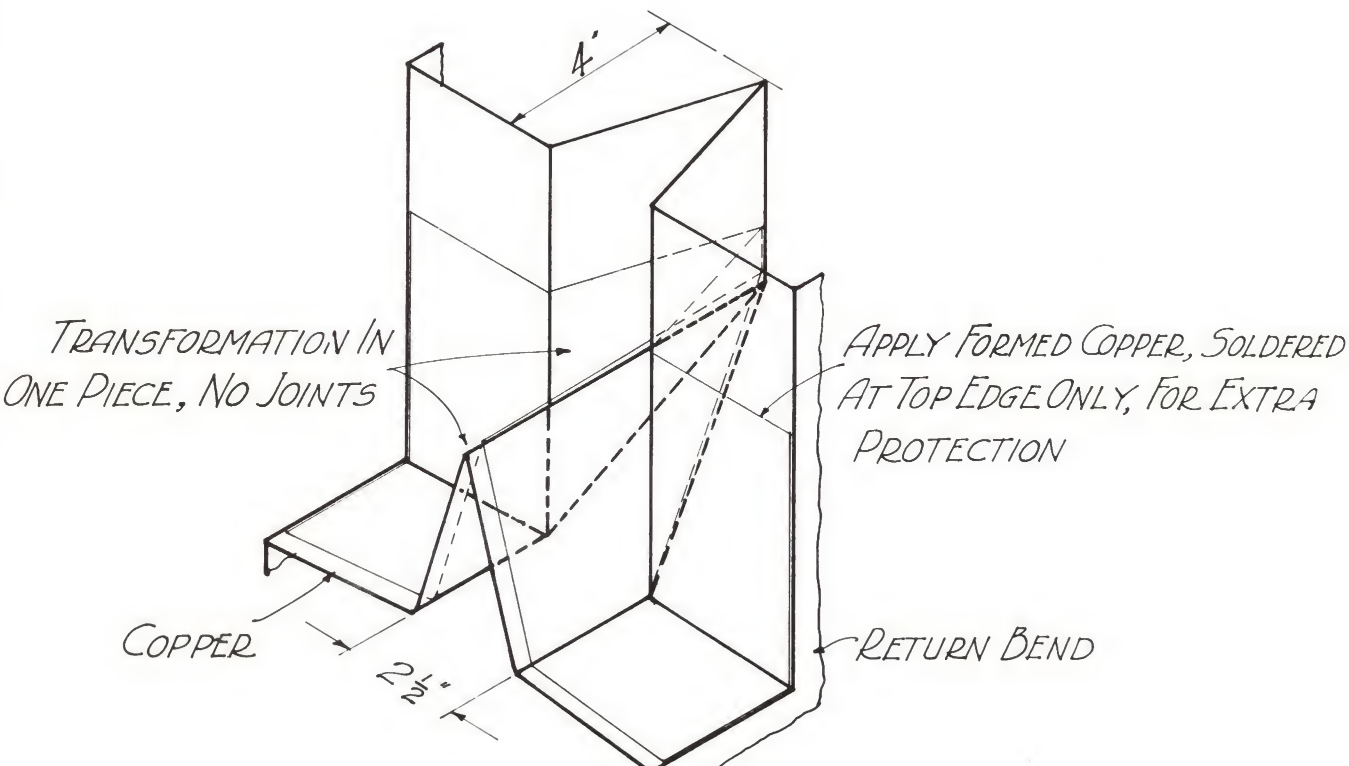
Detail 8 shows construction of expansion joints in floor slabs and ceilings. Water stops are made of not less than 16-oz. soft copper in 8-ft. lengths, with ends lapped 1 inch and soldered. A compressible filler is used to separate the slab sections. At the finished floor, brass angles are anchored to the concrete on both sides of the expansion joint with brass plates fastened to these angles to form a slip joint to provide for movement in the structure. At the ceiling, brass strips are secured to the wood grounds on both sides of the slot with a brass plate fastened to one strip to conceal the opening.

The constructions shown in Details 5, 6, 7, 8, *and this explanation are reproduced from "Copper and Common Sense" of Revere Copper and Brass Incorporated.*

ACCORDIAN FOLD EXPANSION JOINT



VERTICAL TO HORIZONTAL TRANSFORMATION

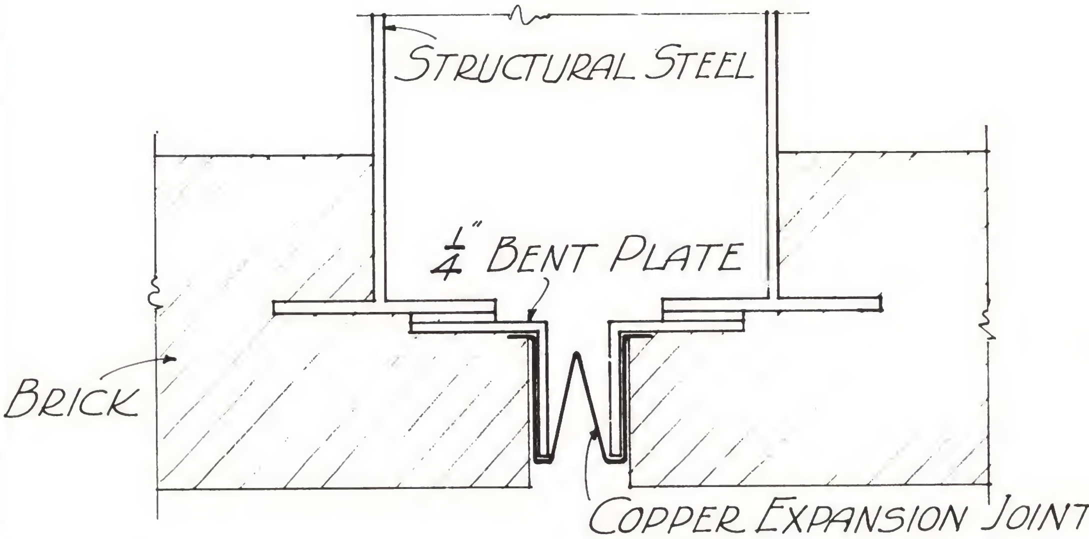


HORIZONTAL TO VERTICAL TRANSFORMATION

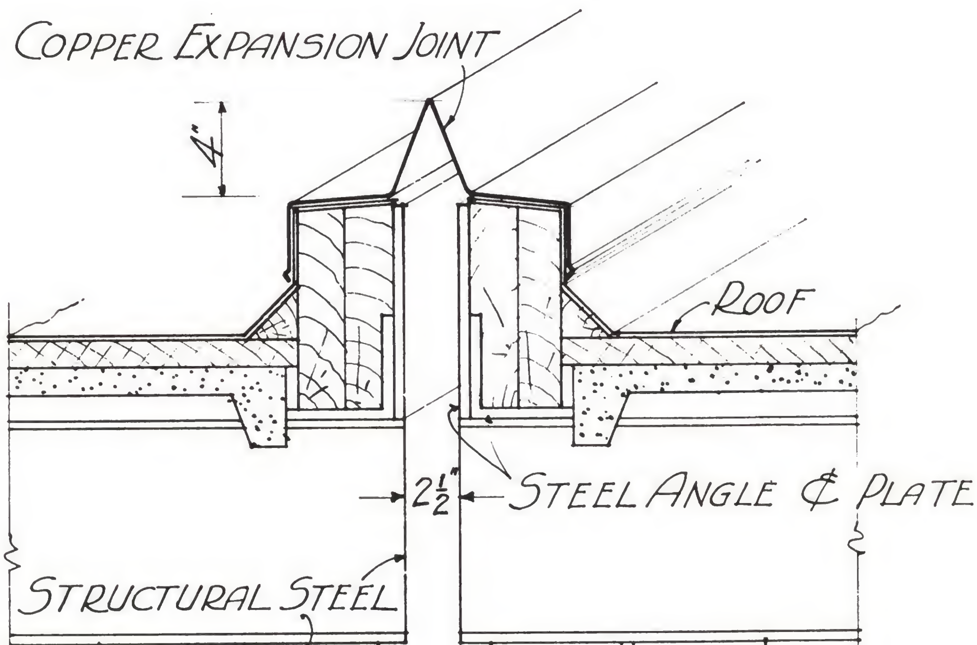
DETAIL I

AMERICAN BRASS COMPANY
DEVELOPED BY ALBERT KAHN and ASSOCIATES, DETROIT, MICH.

ACCORDIAN FOLD EXPANSION JOINT



EXPANSION JOINT IN BRICK WALL

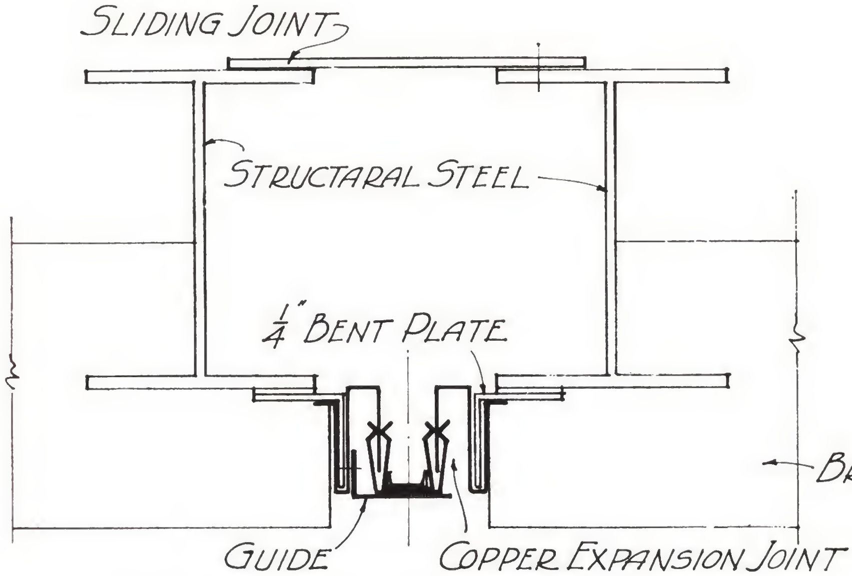


EXPANSION JOINT IN ROOF

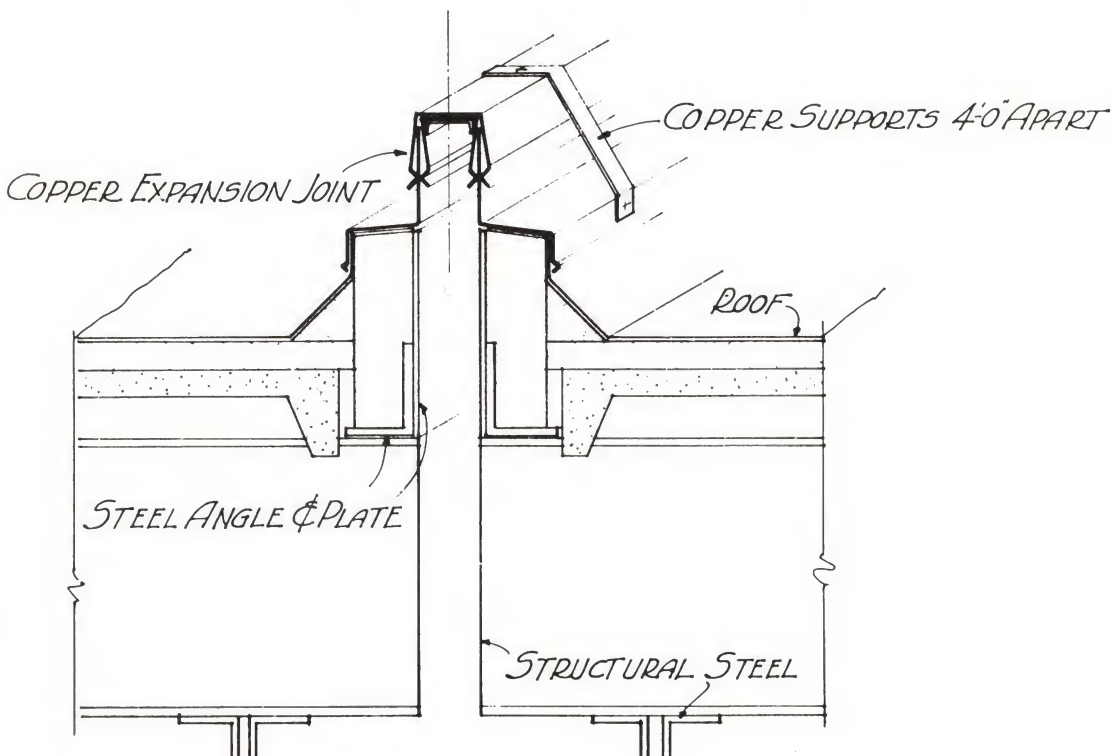
DETAIL **2**

AMERICAN BRASS COMPANY
DEVELOPED BY ALBERT KAHN and ASSOCIATES, DETROIT, MICH.

DOUBLE TONGUE AND SHEATH EXPANSION JOINT



EXPANSION JOINT IN BRICK WALL

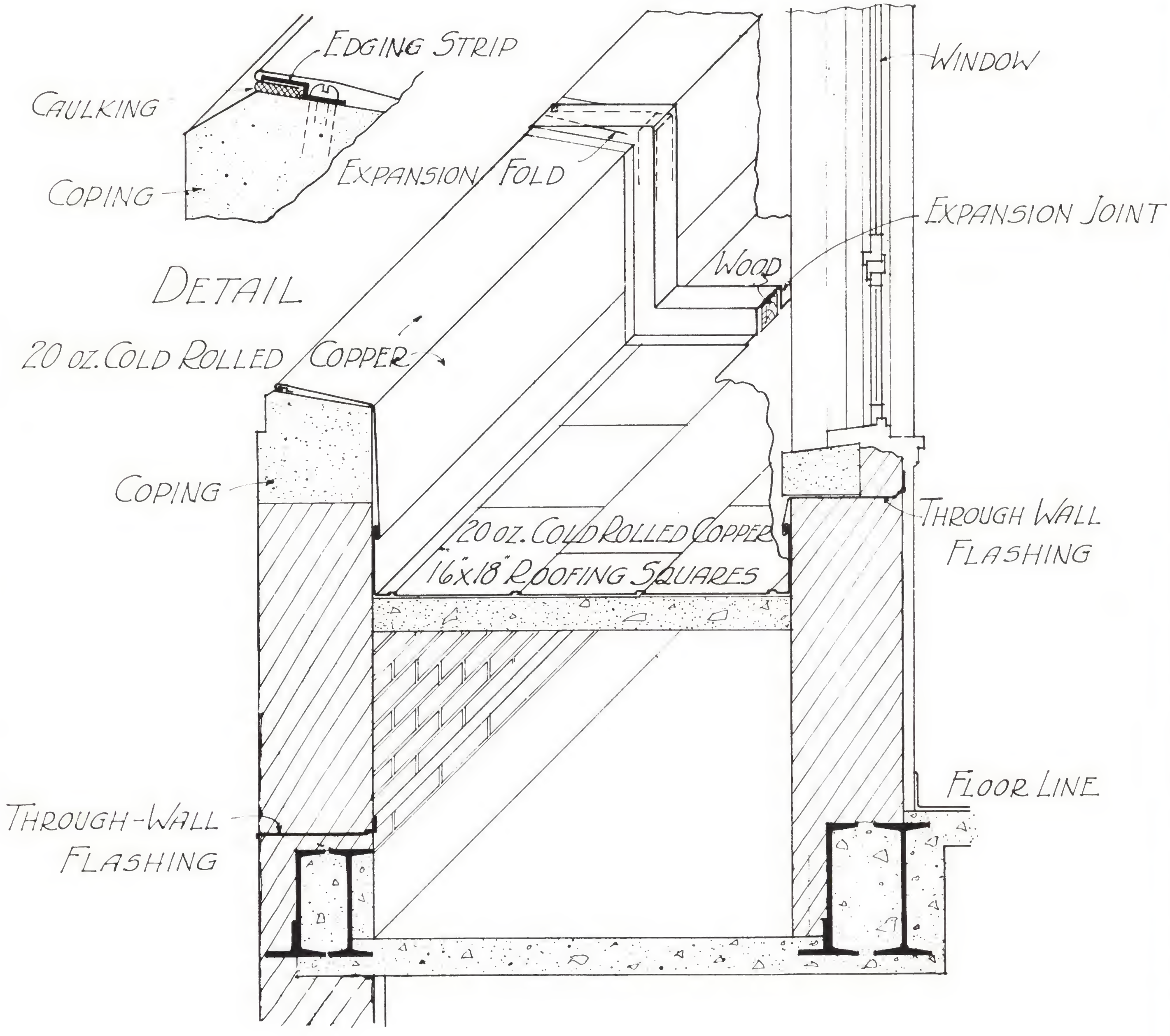


EXPANSION JOINT IN ROOF

DETAIL **3**

AMERICAN BRASS COMPANY
DEVELOPED BY ALBERT KAHN and ASSOCIATES, DETROIT, MICH.

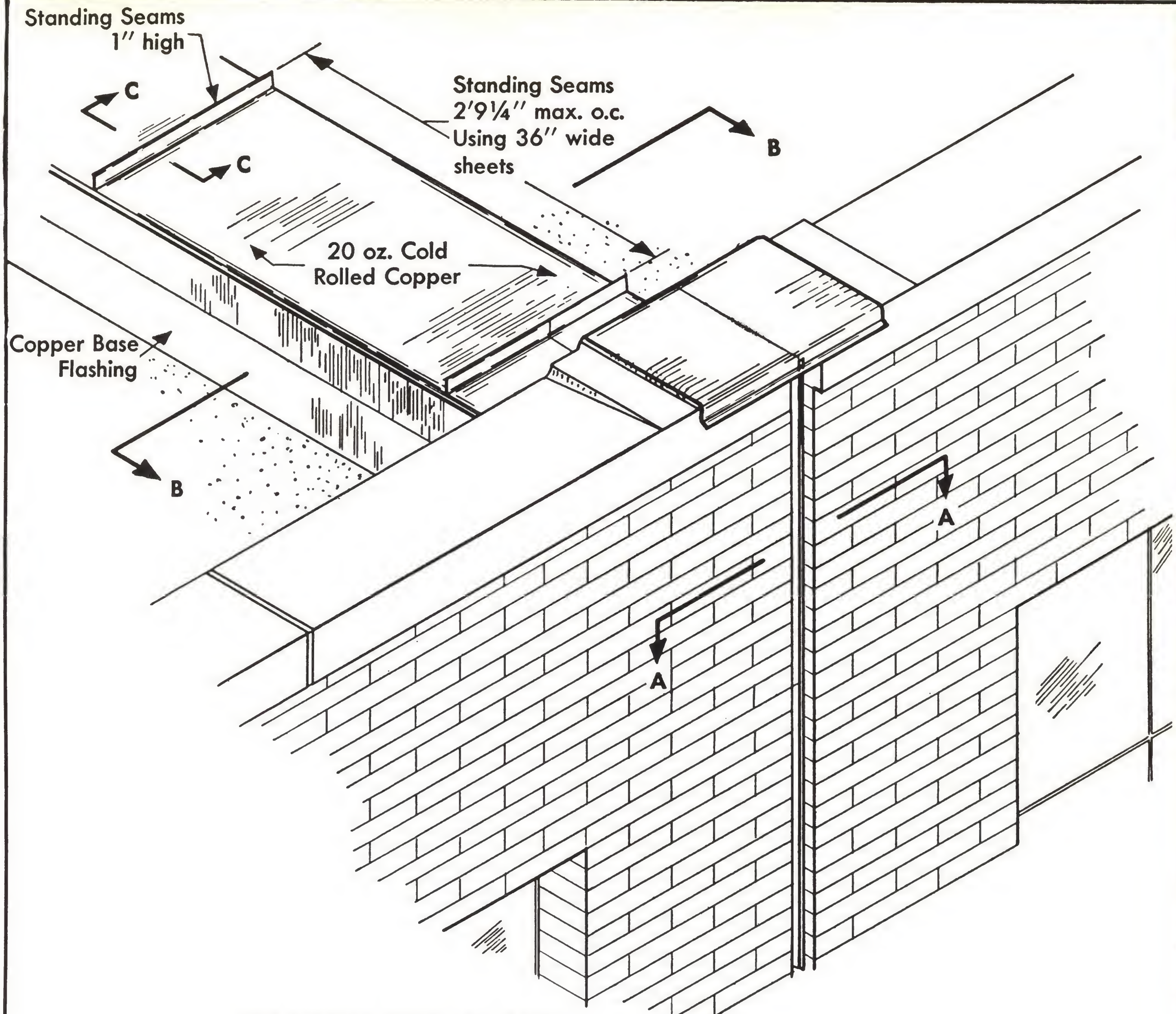
Copper Roofing At Building Set Back



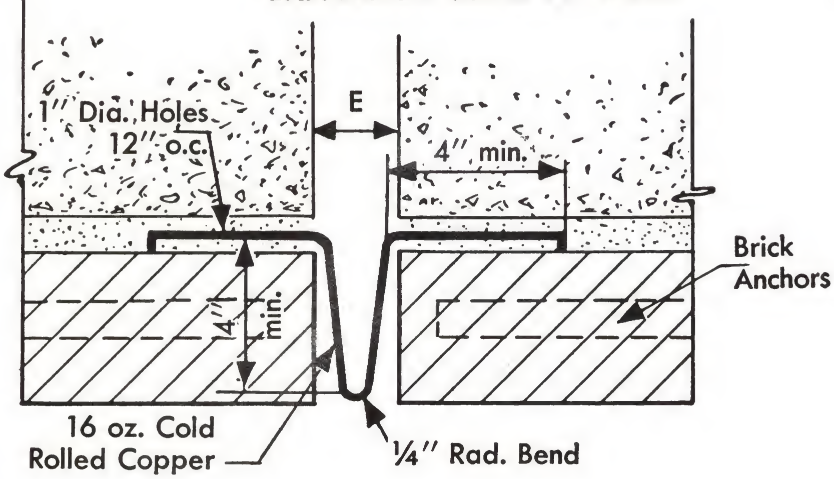
Sectional View

Detail **4**

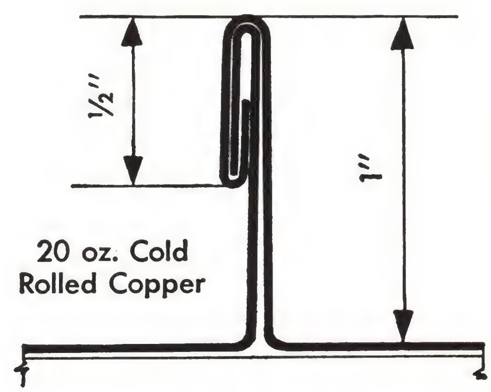
THE AMERICAN BRASS COMPANY
H. E. VOEGELI, DEVELOPMENT ENGINEER



EXPANSION JOINT AT ROOF

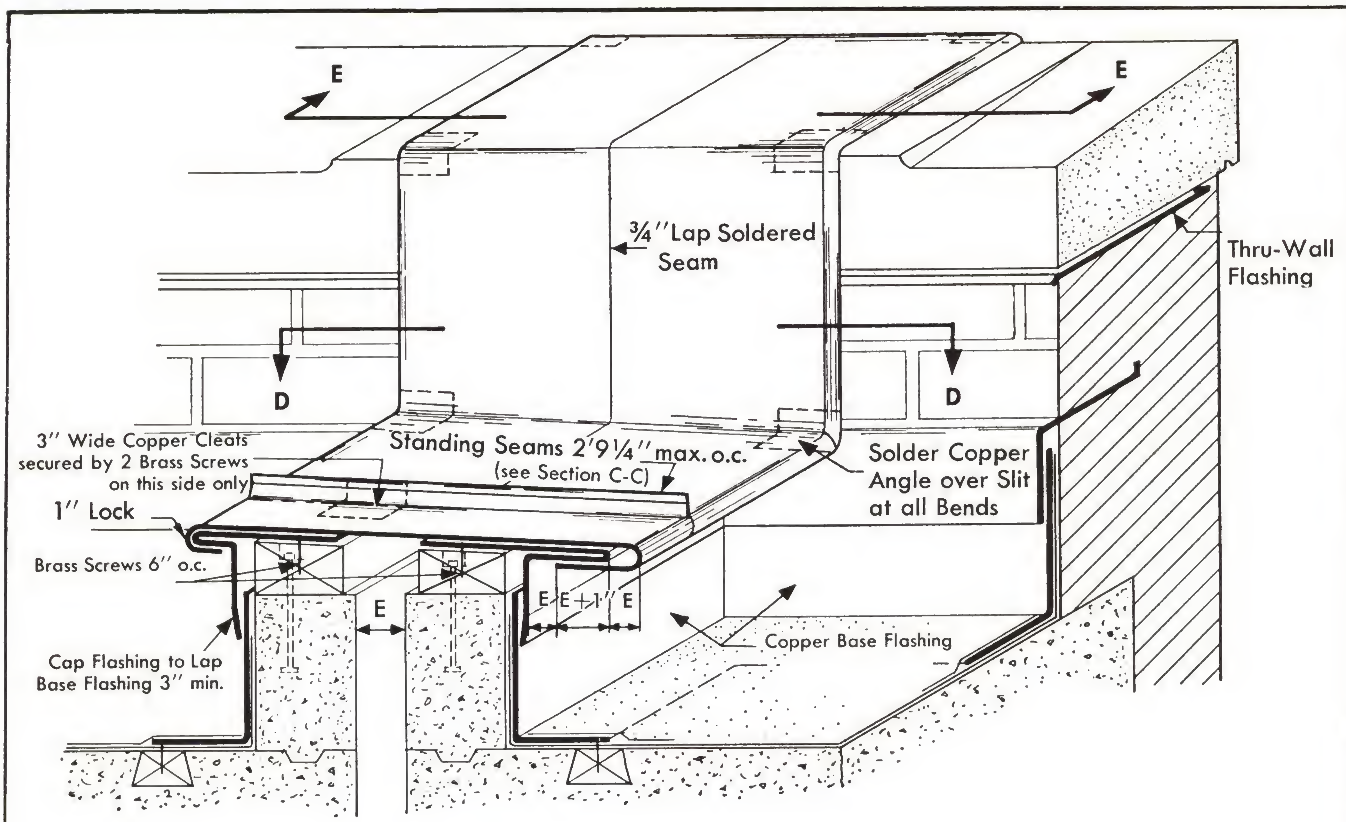


SECTION A-A

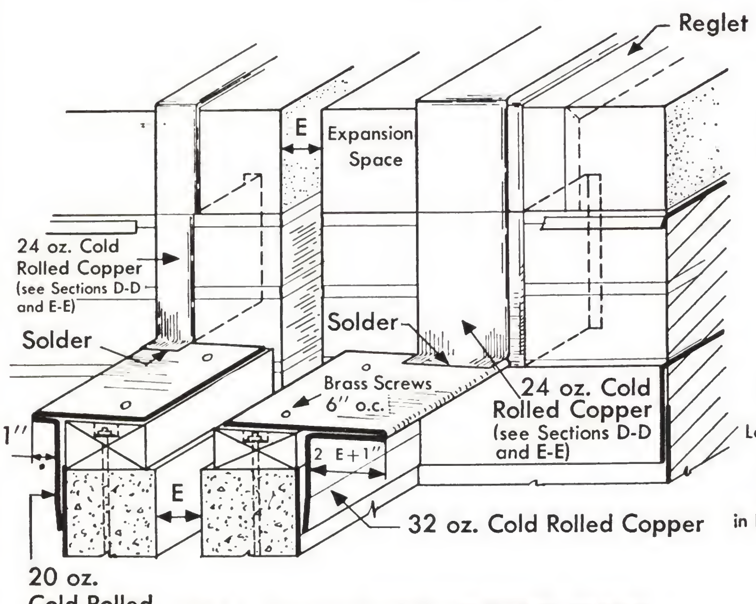


SECTION C-C

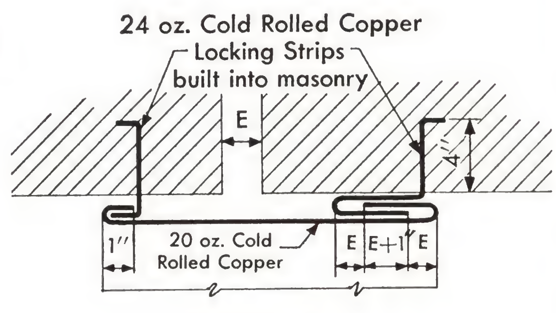
REVERE COPPER AND BRASS INCORPORATED
RESEARCH DEPARTMENT



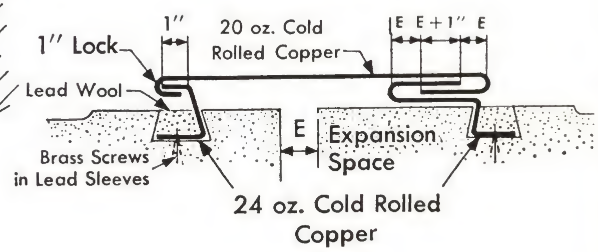
SECTION B-B



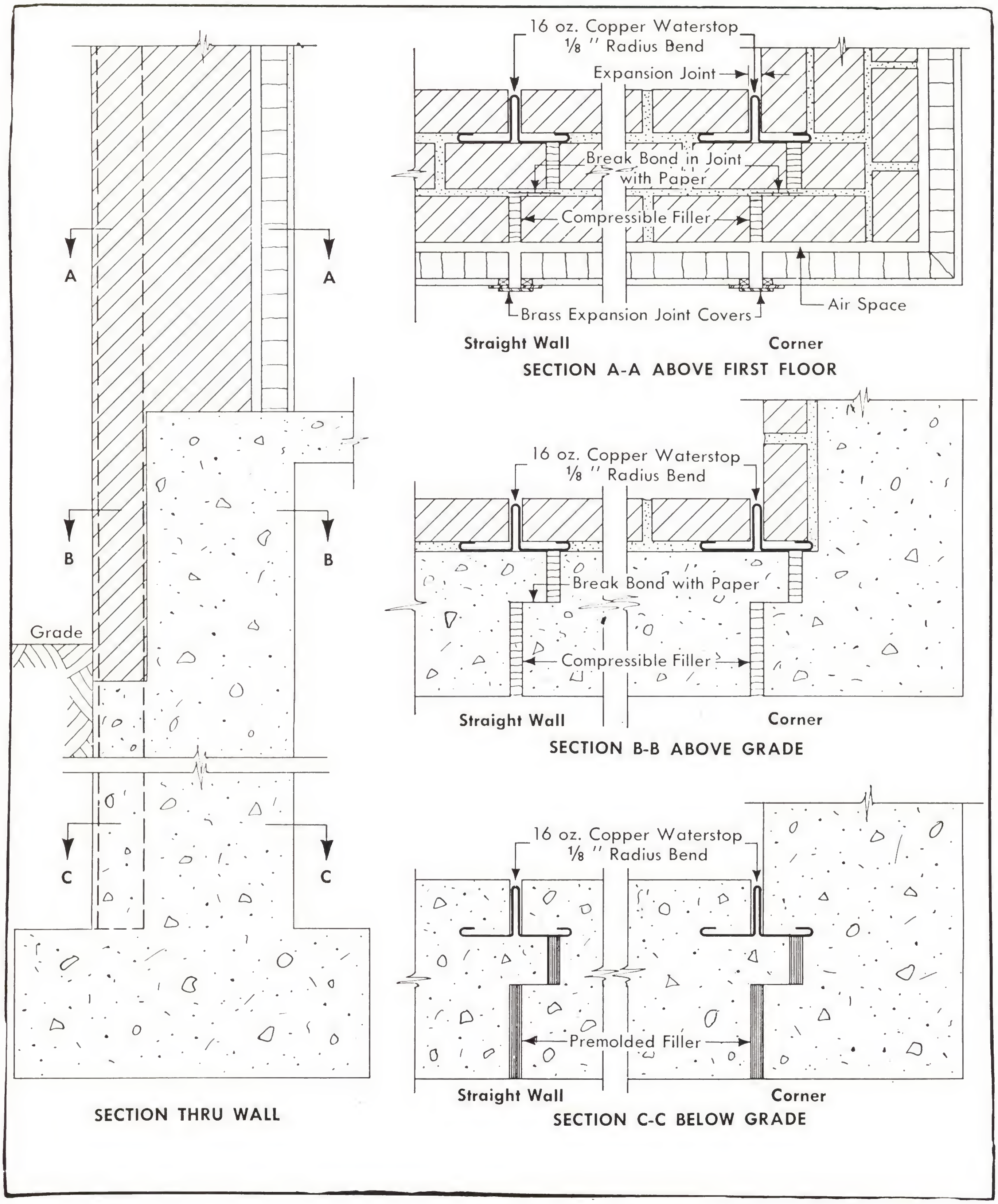
DETAIL OF EDGE AND LOCKING STRIPS



SECTION D-D

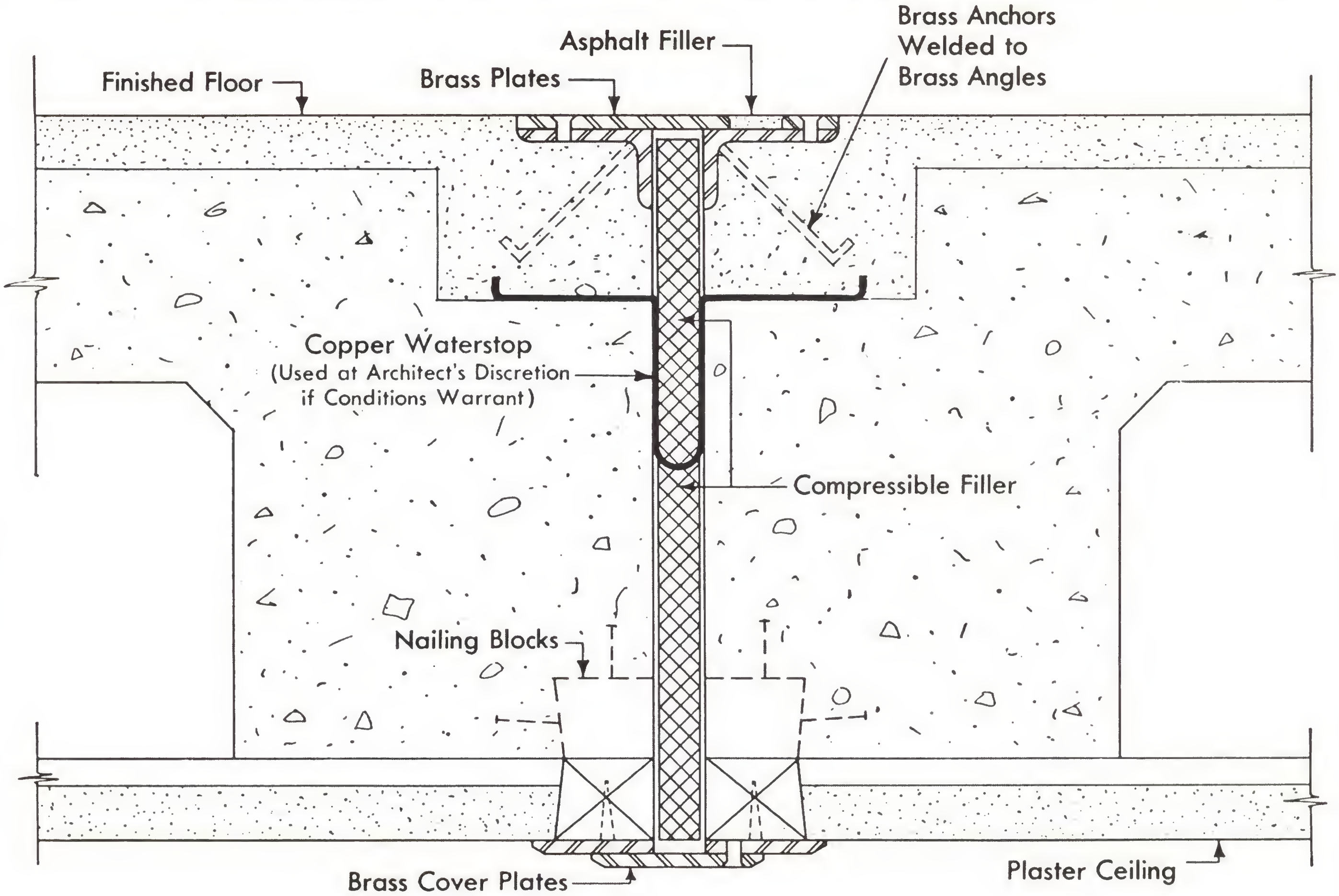


SECTION E-E

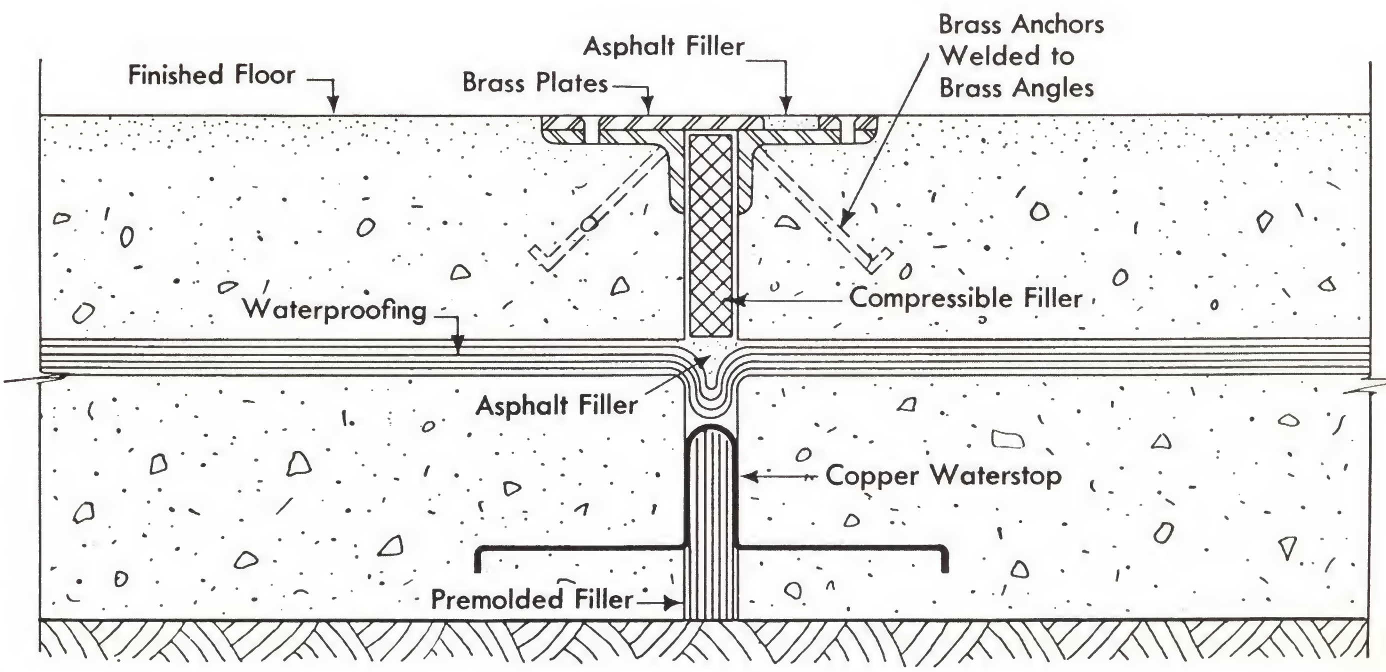


DETAIL **7**

REVERE COPPER AND BRASS INCORPORATED
RESEARCH DEPARTMENT



SECTION — JOINT THRU FLOOR AND CEILING



SECTION — FLOOR SLAB ON FILL

DETAIL **8**

REVERE COPPER AND BRASS INCORPORATED
RESEARCH DEPARTMENT

End Joints

Because flashings of all types must be fabricated and installed in lengths which can be handled, some means must be provided for joining these sections together to provide for expansion and contraction and, at the same time, prevent entrance of water at the joints of the flashing sections.

This requires the use of "end joints."

Because every installation has its own particular characteristics and requirements for flashing application, a variety of end joints have come into use.

This text is a brief analysis of end joint requirement. In general, the elimination of soldered end joints is suggested. The use of "slip" joint connections which allow for lateral movement is recommended.

Of the types of end joints in use, the following general types are mentioned:

1—Lapped joints with rivets or metal screws and soldered.

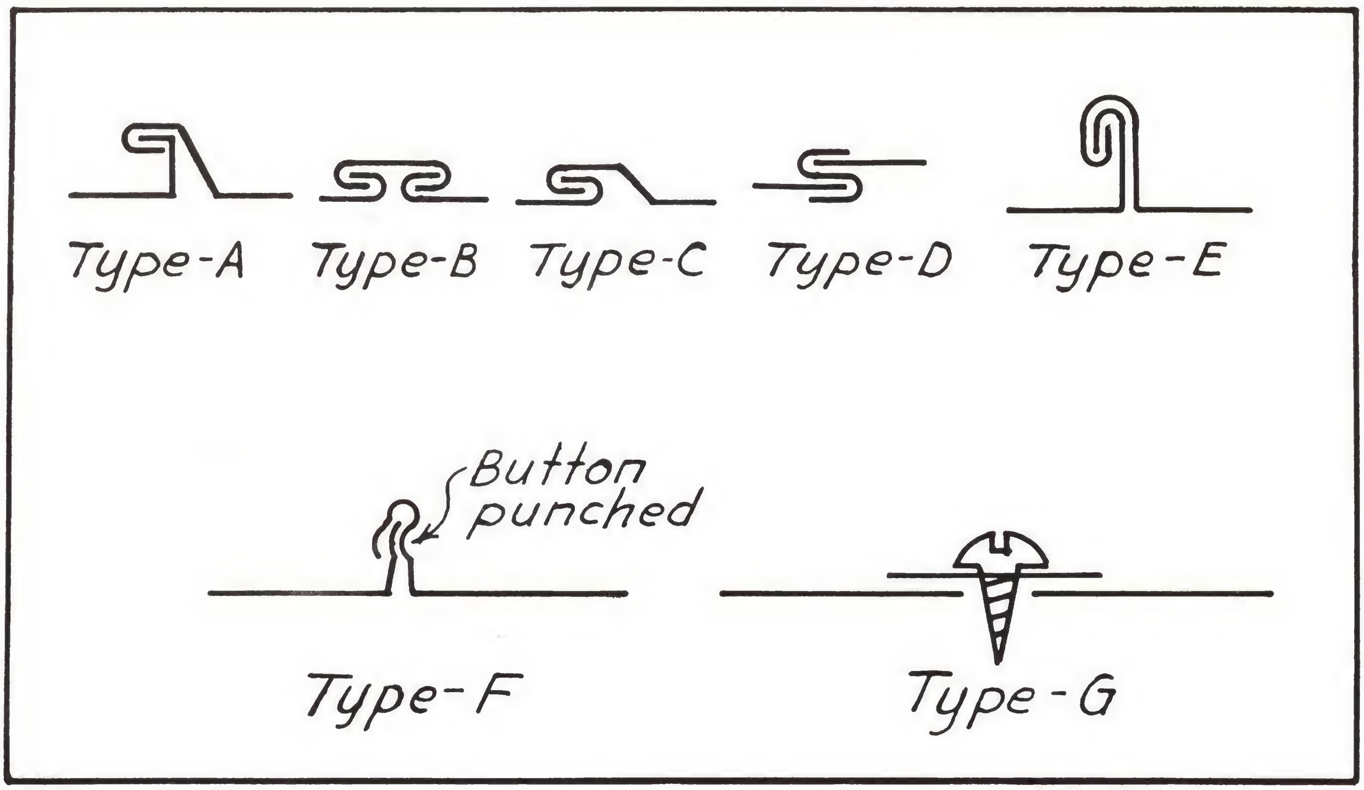
2—Lapped joints with no rivets or screws but soldered. The lap should be at least 3/4 in. and thoroughly soldered. Such construction can be used with copper and Monel metal.

3—Locked joints — soldered.

4—Slip joints using no solder. In the drawing below six types of slip joints are shown. These are indicated in the drawing as Types A, B, C, D, E, F.

5—Lap joints—no solder.

6—Batten seam end joint. In the drawing below one such joint is shown in Type G.



Flashings at Composition Roofing

Drawing No. 21

When the roof has no parapet walls, the high end and sides of the roof are protected and flashed as shown in Fig. 2 below, with a combination drip, gravel guard and roof flashing, formed in one piece.

Before any felt is laid, an angle strip is nailed along the sides and high end of the roof as shown by *A*. The three layers of felt are then applied and over this the flashing is placed hooked to the drip at *B* and nailed along the edge at *C* through the felt. When a stack or flag pole extends through the roof, the method of flashing and allowing for ventilation and vibration is clearly shown in Fig. 3. This illustration shows at the right the method which is used when the flashing is placed around the flag pole and at the left the method employed when the flashing is placed around a smoke stack. In either case, the flashings, collars and hoods are made in two halves after the pole or stack is in place.

After the lower plies of felt are cemented and the pole or stack is in place, the roof flange and collar are set. At least 1 in. space is allowed, as at *F*, for vibration of the pole, as shown at the right and at least 2 in., as at *B*, to allow for ventilation as well as for vibration of the stack as indicated by arrows at the left.

In making the joint between the collar and the roof flange, the edges are flanged as indicated by *X-X* riveted and soldered. The roof flange extends out on the roof not less than 6 in. and is closely nailed through the felt to the sheathing at *A-A*. Note the construction of the hood around the flag pole at the right and also the different construction of the hood around the smoke stack at the left, where a wired edge is placed around the collar at *a* and to this collar four braces are bolted with a band iron ring around the top as shown at *d* which gives a rigid support for the hood. The hood in both cases is secured by two semi-circular bands bolted together as shown in the section on the line *C-D*.

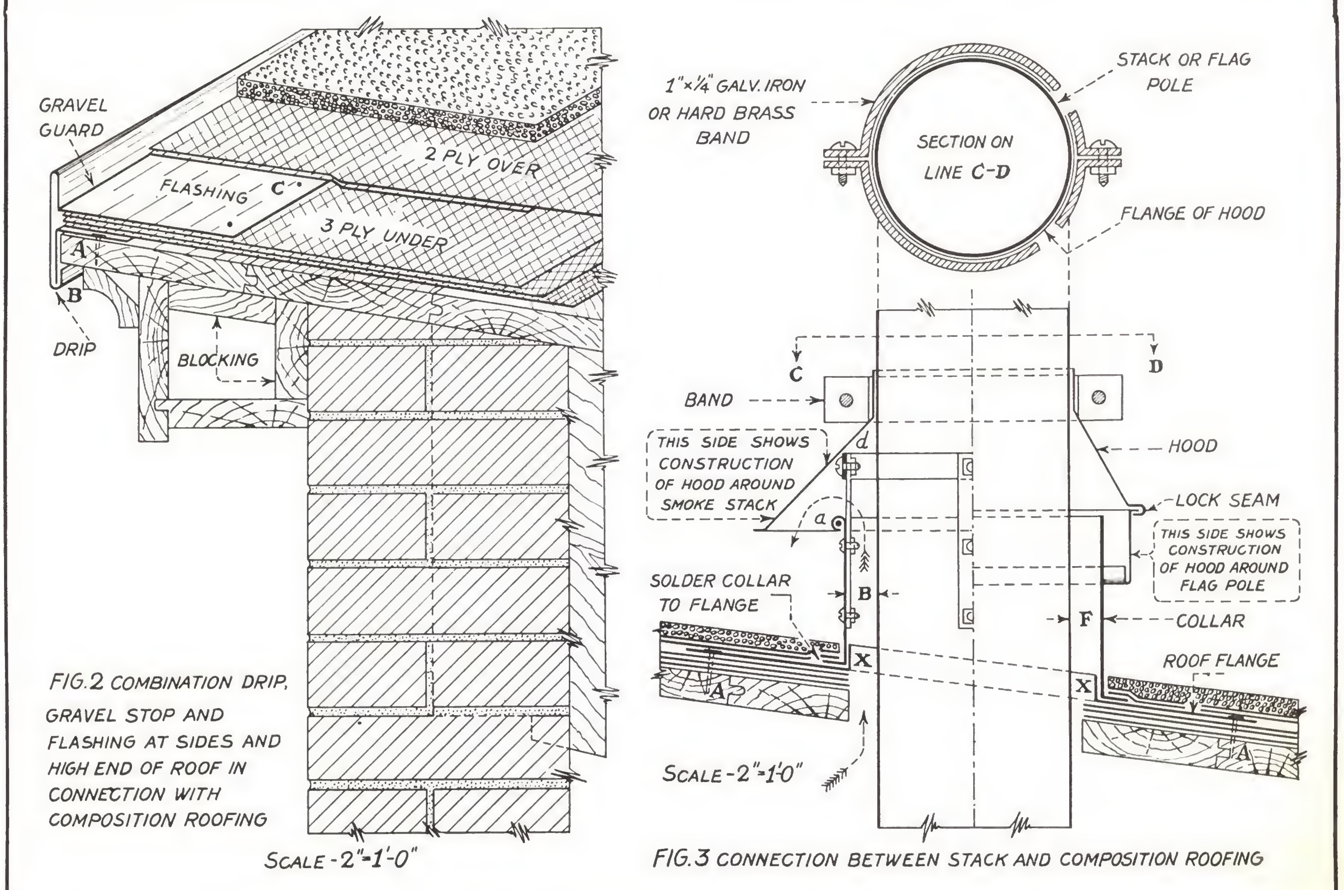


FIG. 2 COMBINATION DRIP, GRAVEL STOP AND FLASHING AT SIDES AND HIGH END OF ROOF IN CONNECTION WITH COMPOSITION ROOFING

FIG. 3 CONNECTION BETWEEN STACK AND COMPOSITION ROOFING

DRAWING NUMBER 21 GUTTER LININGS AND FLASHINGS AT COMPOSITION ROOFING

Flashings Used in Connection with Composition Roofing

Drawing No. 22

Four methods of applying flashings required in connection with composition roofing are presented in Drawing No. 22.

Fig. 1 shows how the flashing is applied when the parapet wall is of brick and the main roof is covered with composition roofing. After the wall is built to the required height over the roof line, a cap flashing is laid, an edge turned up at *X*, which is built in as the masonry progresses.

Sometimes the architect specifies that the entire wall be covered to prevent the seeping of moisture to the inside, which is done as in Fig. 2 where the cap and wall flashing is bent in one piece as shown from *A* to *B* to *C*.

To apply flashing to a concrete wall a reglet *A*, not less than 2 in. deep, is cast at an angle in the wall in which the cap flashing is inserted, as shown in Fig. 3. The cap flashing is secured about 8 or 10 in. apart with lead plugs *B* about $1\frac{1}{2}$ in. wide and then the reglet is filled with roofers' elastic cement.

Sometimes a strut or brace of channel or angle iron cuts through the composition and concrete roof, as shown in Fig. 4. Care is required to make the intersection between the brace and roof, water and damp-proof and also to allow for expansion, contraction and vibration of the steel brace. The lower layers of felt are laid and over these a flashing is placed, as shown, to form a pan. This flashing is secured to the roof and the top layer and slag roofing laid in the usual manner. If pitch is used to fill the pan, the steel brace is heated with a blow torch to secure proper adhesion, especially in cold weather. When filling the pan with pitch or other waterproof compound, a ridge at *H* is formed to shed the water. A section on the line *A-A* is shown above the illustration.

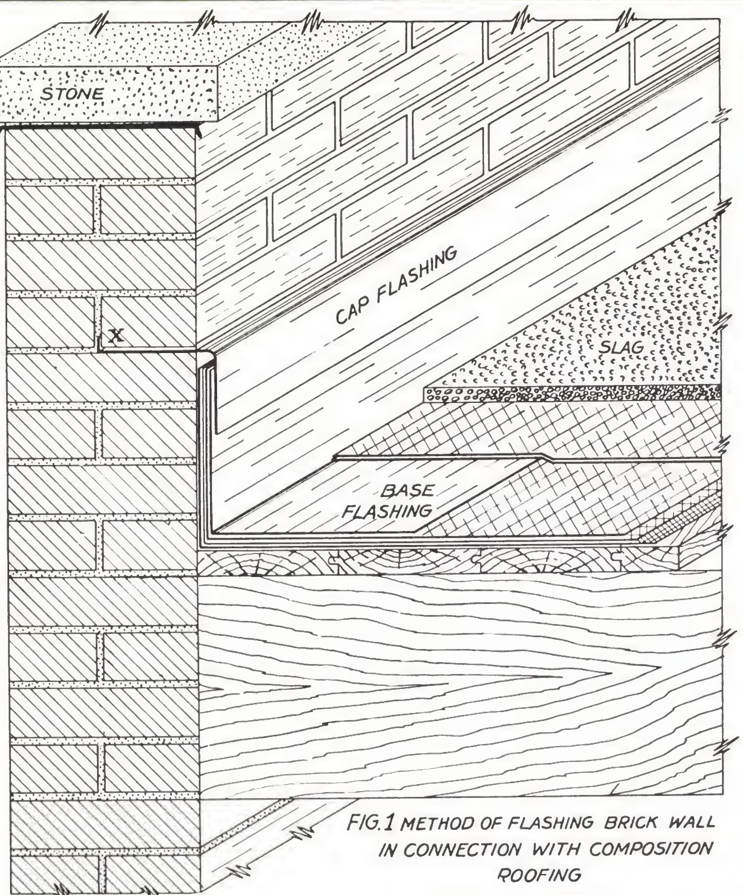


FIG. 1 METHOD OF FLASHING BRICK WALL IN CONNECTION WITH COMPOSITION ROOFING

SCALE - 1½" = 1'-0"

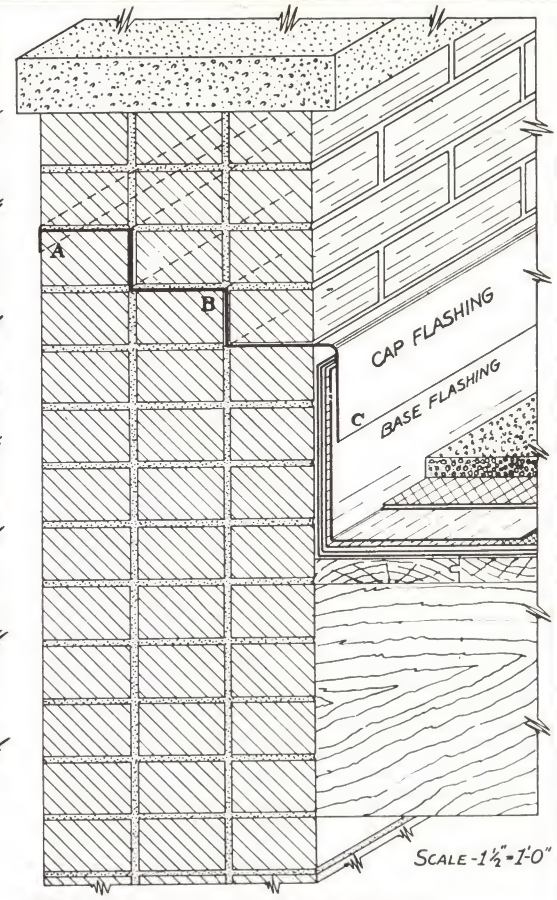


FIG. 2 CAP FLASHING OVER ENTIRE WALL

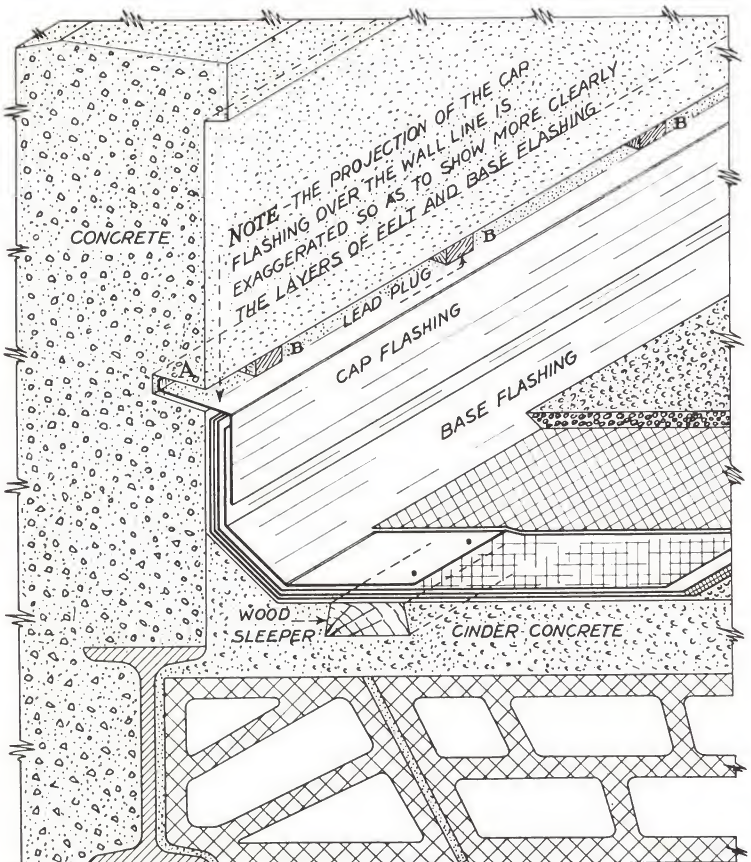


FIG. 3 CONNECTING CAP FLASHING TO CONCRETE WALL IN CONNECTION WITH COMPOSITION ROOFING LAID ON CINDER CONCRETE — SCALE - 1½" = 1'-0"

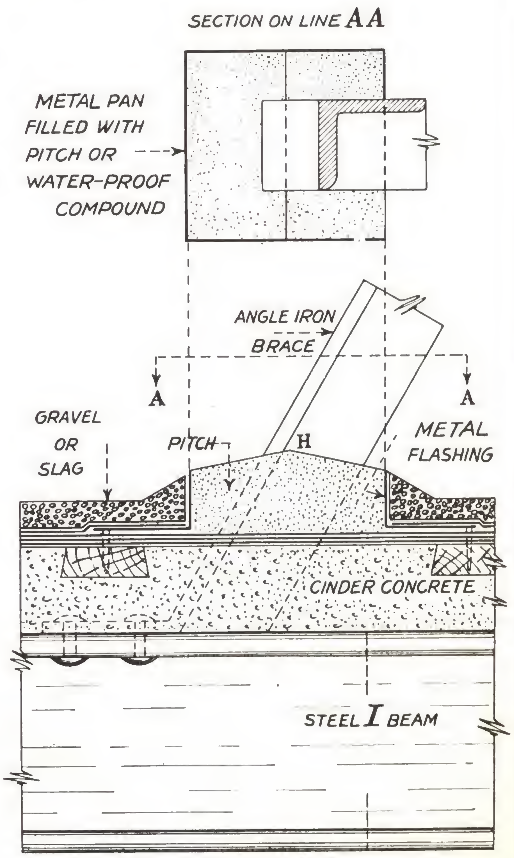


FIG. 4 OBTAINING WATER-TIGHT JOINT AROUND STRUCTURAL STEEL PASSING THROUGH CONCRETE AND COMPOSITION ROOF — SCALE - 1½" = 1'-0"

DRAWING NUMBER 22 FLASHINGS USED IN CONNECTION WITH COMPOSITION ROOFING

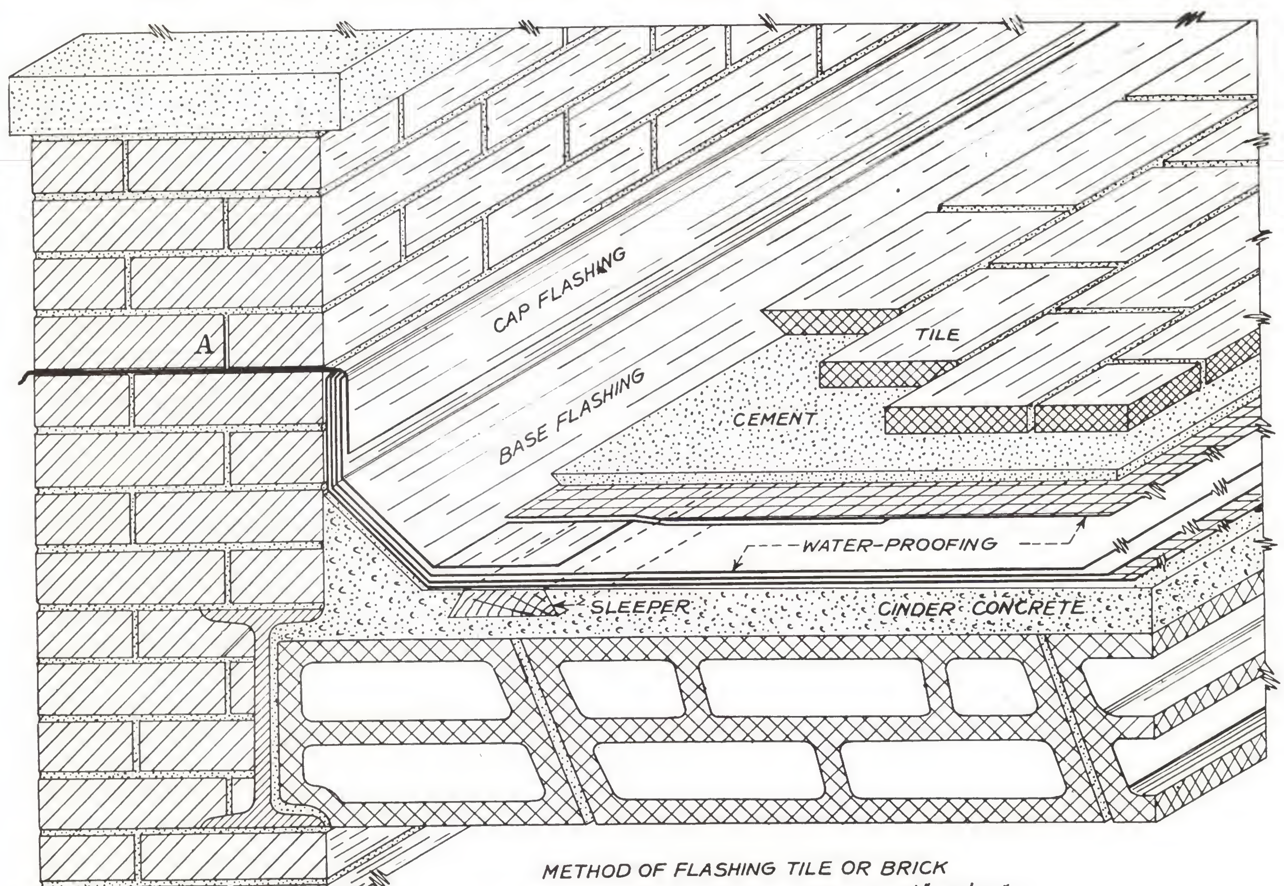
Flashing Used at Tile Deck Roofing

Drawing No. 24

In Drawing 24 is shown the method of flashing tile or brick roofing to a brick wall.

The cap flashing A is built into the wall as a through wall flashing as the masonry progresses.

The base flashing is placed between the water-proofing and felt layers and is carried up—unlocked—behind the cap flashing.



METHOD OF FLASHING TILE OR BRICK ROOFING TO BRICK WALL — SCALE $1\frac{1}{2}'' = 1'\text{-}0''$

DRAWING NUMBER 24 — FLASHING USED AT TILE DECK ROOFING

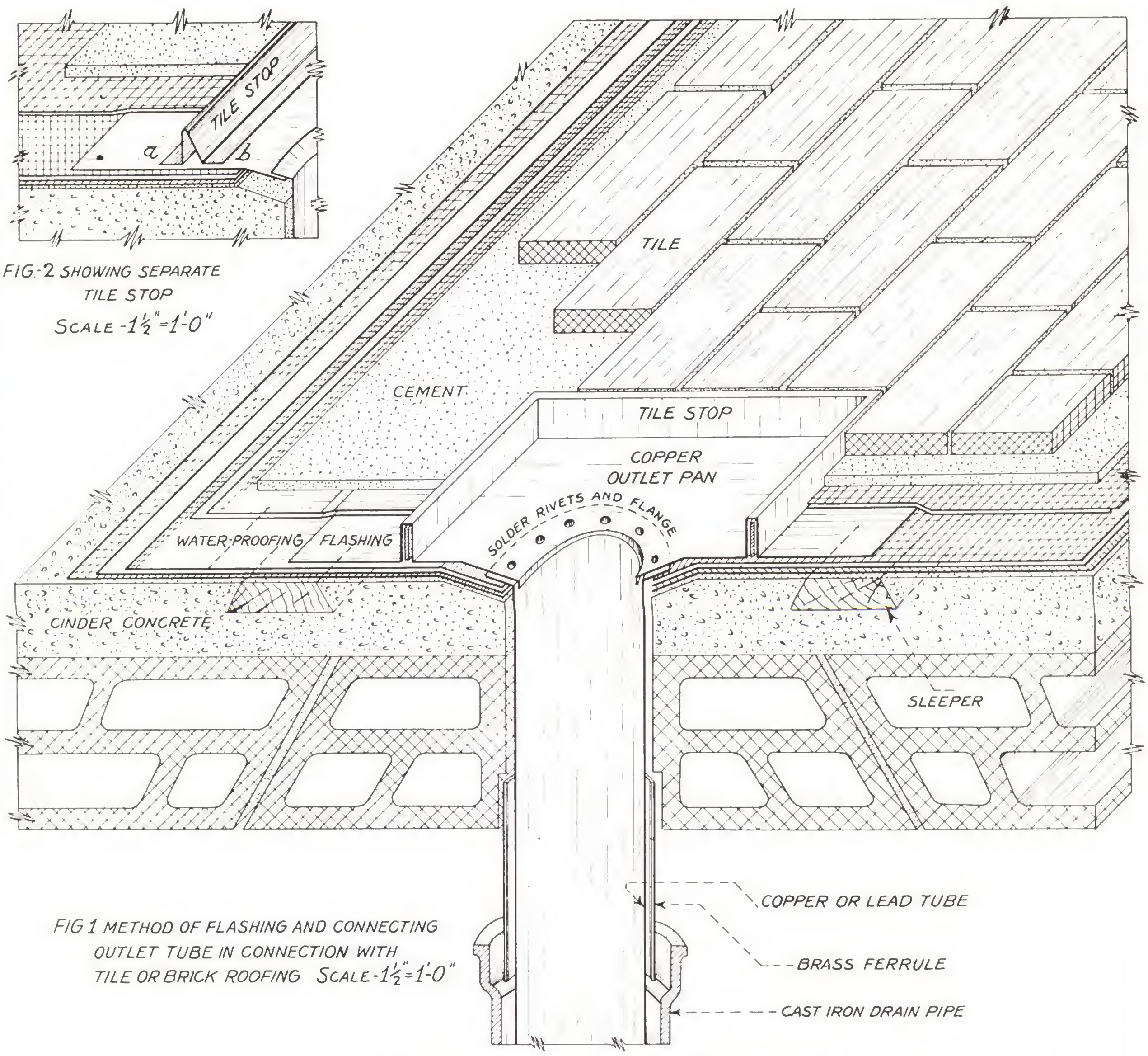


FIG 1 METHOD OF FLASHING AND CONNECTING OUTLET TUBE IN CONNECTION WITH TILE OR BRICK ROOFING SCALE - 1½" = 1'-0"

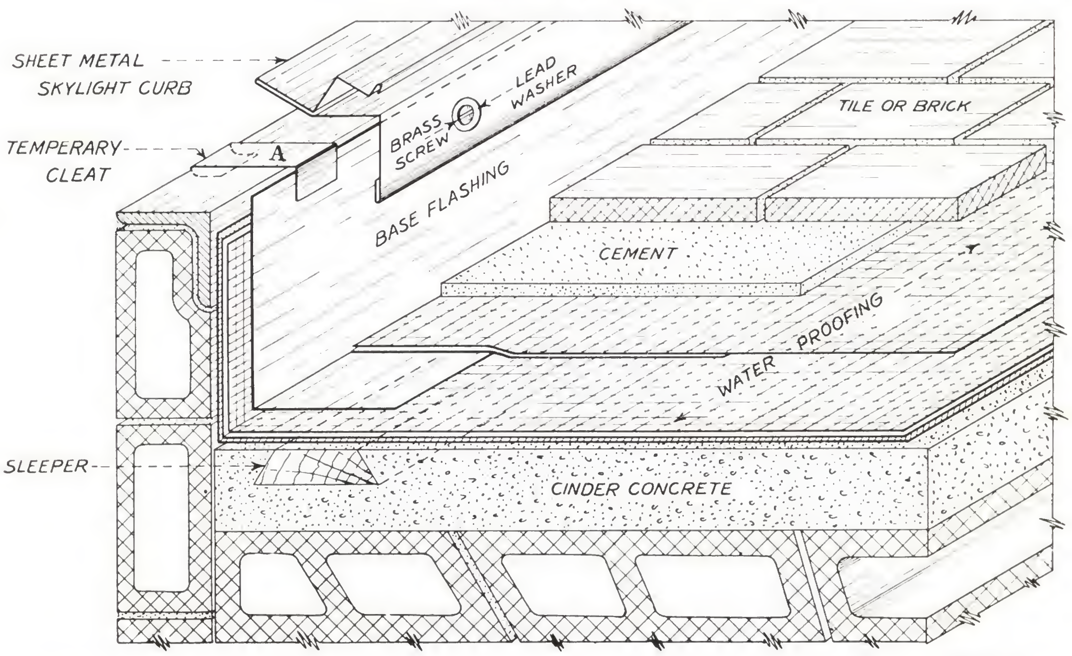


FIG.3 FLASHING SKYLIGHT FRAME IN CONNECTION WITH TILE OR BRICK ROOFING SCALE - 1½" = 1'-0"

DRAWING NUMBER 25

FLASHING USED AT TILE DECK ROOFING

Flashing Used at Tile Deck Roofing

Drawing No. 25

Drawing No. 25 shows the methods of flashing roof outlets and skylights or other structures projecting above the roof line when tile roofing is used for flat roof covering.

The outlet connection to an inside drain pipe is presented in Fig 1. When the cinder concrete fill is being graded to the outlet, the cement is slightly beveled around the outlet, as shown, to allow free movement of the rain water. Sleepers are inserted in the concrete for nailing the flashing. After the lower plies of the waterproofing are thoroughly cemented with hot pitch, the combination flashing, tile stop pan and tube is nailed in position, connecting to the inside drain. Note that the tube is flanged and riveted to the underside of the pan and then thoroughly sweated with solder to avoid water flowing against the seam. The tube extends in the cast iron pipe not less than 6 in. If the outlet tube is of copper, it is heavily coated with asphaltum before connecting to the iron pipe. A brass ferrule is soldered to the tube for caulking to the iron drain pipe by the plumber. A band of iron or brass is placed in the stop for stiffening purposes. If iron is used, it receives a heavy coating of asphaltum before insertion.

Over the tube a proper size strainer is placed to prevent stoppage of the iron drain. Over the flashing the upper layers of waterproofing are cemented, then tile is laid in cement in the usual manner and the joints filled with cement.

Another type of tile stop is shown in Fig. 2. Here the flashing is one piece of metal of the required size and over this the tile stop is tacked with solder at *a* and *b* to allow the seepage of any water from the roof to enter the outlet pan.

Fig. 3 shows the flashing against angle iron skylight or other frame. The method of flashing shown is applicable to any curb construction when the flat roof is covered with tile. When the curb construction is of angle iron, the angle iron coming in contact with metal receives a heavy coat of asphaltum before applying the sheets. The base flashing is set over the lower layers of waterproofing and extends up to the top of the iron angle. Temporary cleats, shown by *A*, are hooked to the iron angle and turned down over the flashing but not soldered. After the skylight curb is set, holes are tapped in the angle iron about 36 in. apart and the curb secured to the frame, brass machine screws and lead washers being used. If the outside of the curb is wood sheathed, brass wood screws and lead washers are employed to secure the skylight curb.

Gravel Stop and Approved Strainer

Drawing No. 26

In Drawing No. 26 is shown an approved outlet and strainer for slag surfaced roofs.

The gravel stop presented in Fig. 1 is placed around the edge of the outlet tube. The flashing piece and tube are constructed as follows: In the center of the flashing plate a circle representing the diameter of the tube is struck, and another circle ½ in. less in radius is then struck from the same center to allow for a flange to be turned up at right angles as shown in the illustration. Before the tube is rolled up a ½-in. hem edge is turned on one end and then passed through the rolls, care being taken to insert a strip of metal to prevent the hem edge from being crushed when rolling. This tube is then slipped over the single edge on the flashing piece and well soldered. A perforated cylinder is fitted snugly into the outlet and a regulation wire strainer set in place, all as indicated in the drawing. The tube is connected to an inside drain.

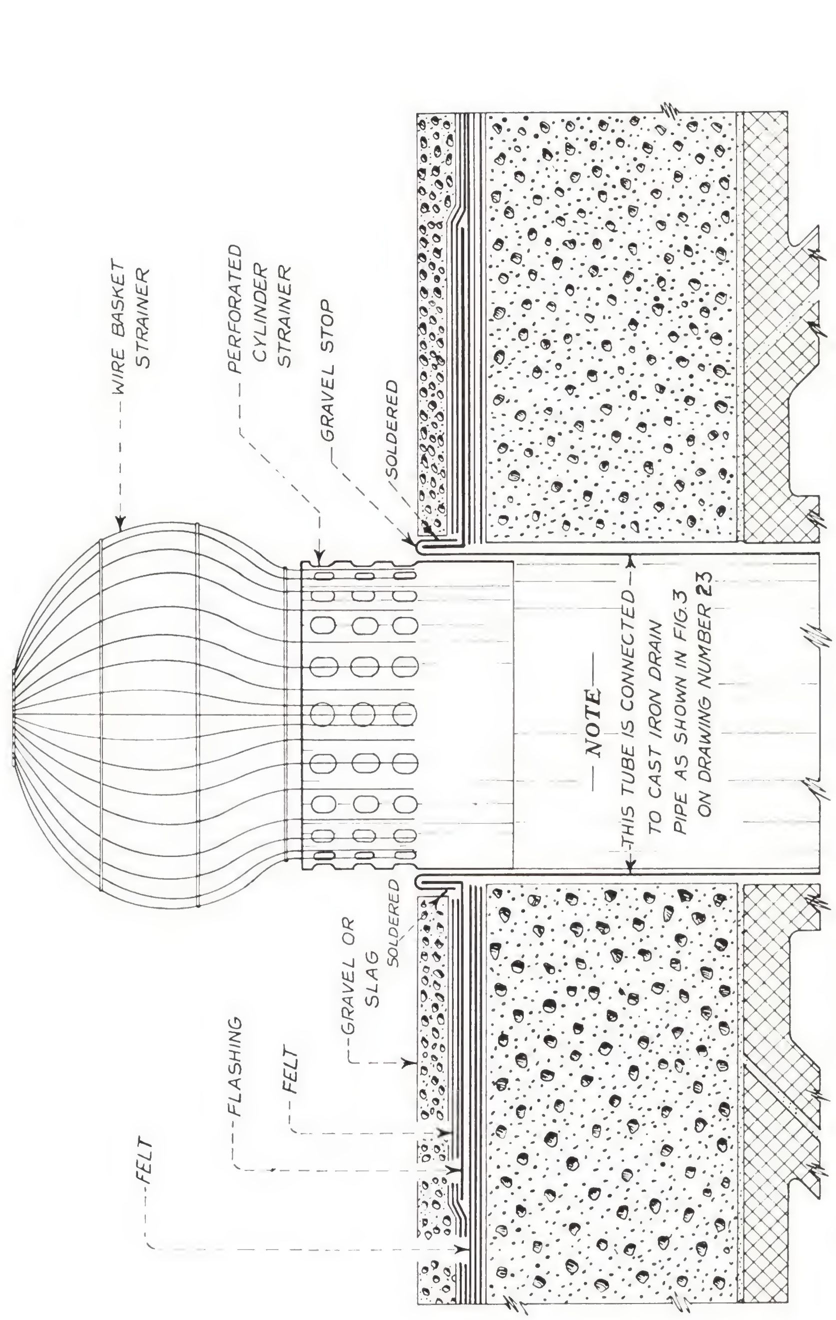


FIG.1 METHOD OF CONSTRUCTING GRAVEL STOP AROUND EXTREME EDGE OF OUTLET TUBE WITH APPROVED STRAINERS

DRAWING NUMBER 26 GRAVEL STOP AND APPROVED STRAINER

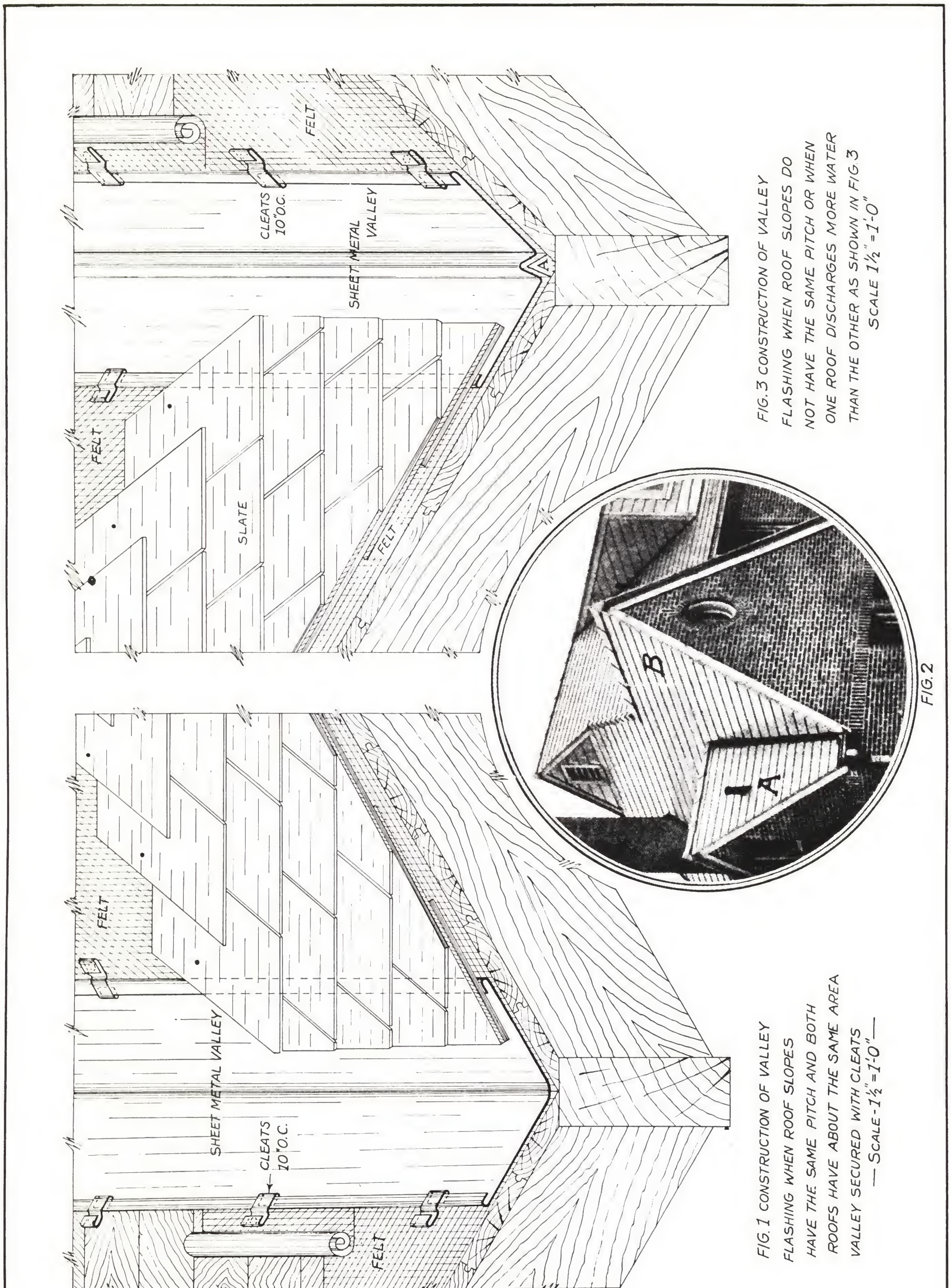


FIG. 3 CONSTRUCTION OF VALLEY FLASHING WHEN ROOF SLOPES DO NOT HAVE THE SAME PITCH OR WHEN ONE ROOF DISCHARGES MORE WATER THAN THE OTHER AS SHOWN IN FIG. 3
SCALE 1½"=1'-0"

FIG. 2

FIG. 1 CONSTRUCTION OF VALLEY FLASHING WHEN ROOF SLOPES HAVE THE SAME PITCH AND BOTH ROOFS HAVE ABOUT THE SAME AREA VALLEY SECURED WITH CLEATS
— SCALE-1½"=1'-0" —

DRAWING NUMBER 29

OPEN VALLEY ON SHINGLE, SLATE OR FLAT TILE ROOFS

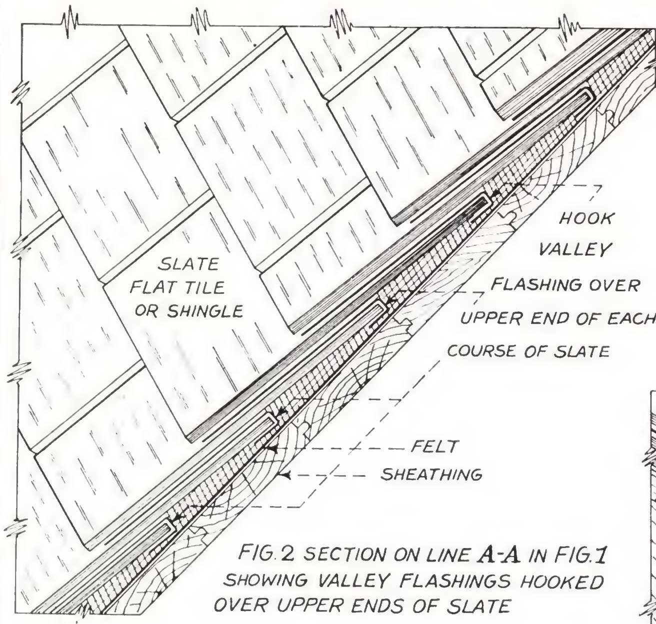


FIG. 2 SECTION ON LINE **A-A** IN FIG. 1 SHOWING VALLEY FLASHINGS HOOKED OVER UPPER ENDS OF SLATE

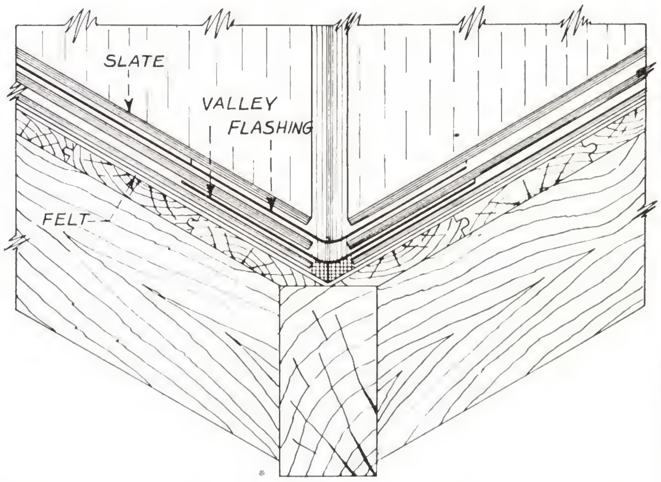
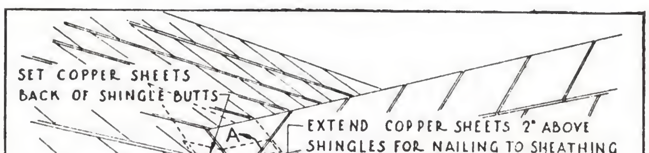


FIG. 3 SECTION ON LINE **B-B** IN FIG. 1 SHOWING INSERTION OF VALLEY FLASHING UNDER EACH SLATE



DRAWING NUMBER 30

CLOSED VALLEYS ON SLATE, FLAT TILE OR SHINGLE ROOFS

Open Valley on Shingle, Slate or Flat Tile Roofs

Drawing No. 29

Two types of open valleys which are used when the pitch of the roof is less than 8 in. in 12 in. are presented in Drawing No. 29.

Fig. 1 shows the construction of the valley when the roof slopes have the same pitch and both roofs have about the same area. Regular lock edges are turned at both sides of the sheet metal which is secured with cleats spaced about 10 in. on centers. The cross joints are not soldered but overlapped not less than 6 in.

When the roof slopes are of different pitch or when one roof discharges more water than the other, as shown in Fig. 2, in which roof *B* has a larger area and a steeper pitch than roof *A*, an inverted *V* is formed in the valley, as shown in Fig. 3. This serves to break the force of the water from the larger roof and prevents it being forced above the top of the flashing on the opposite slope. Care is taken to place a wood core under the inverted *V* as at *A* to prevent crushing while the roofing is being laid.

Closed Valleys on Slate, Flat Tile or Shingle Roofs

Drawing No. 30

In Drawing No. 30 is presented the method employed when a closed valley is laid on a slate, flat tile or shingle roof.

The short pieces of valley flashings are laid in with the courses of slate, care being taken to hook the upper end of each valley flashing over the upper end of each course of slate. The flashing laps over on each side of the roof not less than 7 in. and has four top lugs about 1 in. wide and $1\frac{1}{2}$ in. long. These lugs are bent over the top of each course of slate as shown .

The length of the flashing is determined by the exposure to the weather. This is clearly shown in Fig. 2, which represents a section taken on the line *A-A* in Fig. 1.

A section, taken on the line *B-B* shown in Fig. 3, indicates how the valley flashings are inserted between the courses of slate, and needs no further description.

Hip Flashing and Covering on Slate or Flat Tile Roofs

Drawing No. 31

The method of making water-tight connections against a wooden hip pole by the use of shingle flashings and capping with sheet metal hip roll with aprons attached is indicated in Drawing No. 31.

In Fig. 1 is presented a perspective showing the sheet metal cornice, the gutter lining flashed up on the roof not less than 6 in. as shown at *X*. Note that the roof flashing *X* is carried over the wooden hip pole as indicated at *Y*, which prevents leakage at the corner of the hip. The under eaves course is laid first, care being taken to have the nail above the lock edge as shown.

Shingle flashing 1 is then laid, the top of the flashing being hooked over the top of the eaves slate as shown at *a*. The first course is then laid over the flashing and then the flashing marked 2 is hooked over the top of the first course at *b*, and so on as shown in the illustration.

Note that the shingle flashings numbered 3, 4 and 5 hook over the courses at *c*, *d* and *e*, respectively. Hooking the flashings over the top of each course of slate prevents them from sliding down. The shingle flashings are never nailed against the hip pole.

Fig. 2, an enlarged detail, shows more clearly how the flashings are secured to the upper ends of the slate, flat tile or shingles. Over these shingle flashings, shown in Fig. 1, a sheet metal hip roll with an apron on each side to cover the nail heads of the top course of slate is secured to the wooden hip pole with clamps as shown in the enlarged detail in Fig. 3, which explains itself.

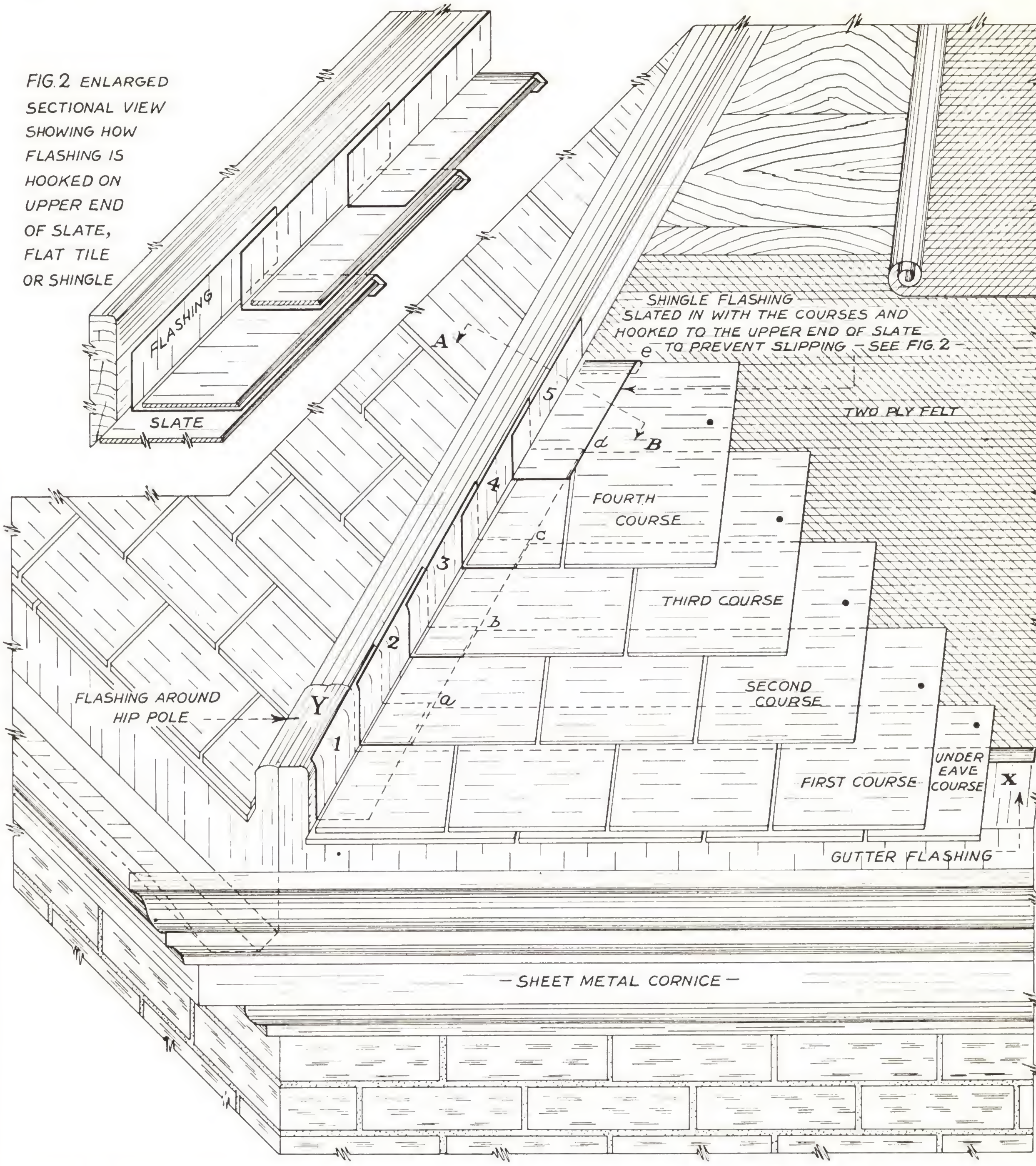


FIG. 1 METHOD OF USING SHINGLE FLASHING AT HIP IN CONNECTION WITH SLATE, FLAT TILE AND SHINGLE ROOFING
SCALE - 1" = 1'-0"

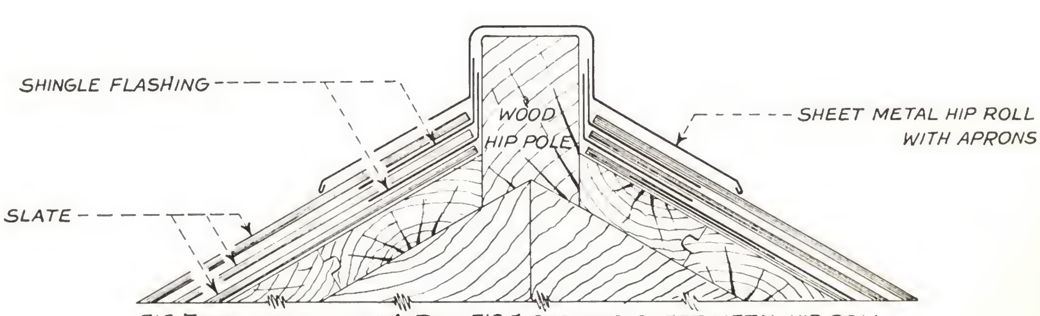


FIG. 3 SECTION ON LINE **A-B** IN FIG. 1 SHOWING SHEET METAL HIP ROLL
SCALE - 3" = 1'-0"

DRAWING NUMBER 31

HIP FLASHING AND COVERING ON SLATE OR FLAT TILE ROOFS

Hip and Ridge Flashing for Slate or Flat Tile Roofs

Drawing No. 34

The methods of slating hips and ridges with and without flashings are presented in Drawing No. 34. This drawing also shows how flashings are inserted over the nail heads to prevent leakage, when hips or ridges of pitched roofs are covered with slate, flat tile or shingles in place of a sheet metal ridge roll or saddle.

As shown in the upper part of Fig. 1, wood strips are first nailed along the hip and ridge to which the hip or ridge slates are secured. When the gutter is lined, the sheet metal is turned up the roof not less than 6 in. as shown and is carried over the wood strips at the hips, making a continuous flashing at the eaves from *A* to *B* to *C*.

The roof is then covered in the usual manner, as shown up to *D*. Slates used for hip covering are laid to cover the nail heads at *D* at least 4 in. They are nailed to the wood strips, care being taken to miter them where they intersect as at *B*. The nail heads are covered with flashing, the upper end of the flashing being hooked over the top edge of the slate, as shown at *a* and *b*. When the flashing is hooked to the top of the slate, it is necessary to allow for only two lugs about 1 in. wide, as shown by *a* and *b* in Fig. 2.

Fig. 3 shows a finished view of a hip covered with slate.

Chimney and Saddle Flashing for Slate or Flat Tile Roofs

Drawing No. 35

Drawing No. 35 shows how chimneys and saddles are flashed when the roof covering is either slate, flat tile or shingles.

The flashing of the front and side of a chimney are presented in Fig. 1. After the course *S* is laid, the base flashing and shingle flashing *A* is set in position, a hem edge being placed along the bottom of the base flashing to insure stiffness as shown by the broken view marked *B*. Over the flashing *A*, course *T* is laid, a separate shingle flashing being used with each course. When the course *V* is reached, the saddle flashing behind the chimney is laid to overlap the slate course *V*. Care is taken to hook each shingle flashing to the upper end of the slate, as shown in Fig. 2 on Drawing No. 31.

The base and shingle flashings are cap flashed, as shown, the upper flange entering the brick joint not less than 4-in. , secured with lead plugs 1 in. wide and placed 8 in. on centers and the joints filled out with roofers' elastic cement.

When possible to do so, the cap flashing is built in the wall as the masonry progresses. Where the saddle flashing is turned around over the shingle flashing in the broken view at *C* and the corner at the lower end *A* of the chimney, the joints are well soldered.

Fig. 2 shows how the side of the chimney and saddle behind the chimney are flashed. A detailed section on the line *A-B* is given in the lower right hand corner which shows the cap flashing overlapping the upturned flashing of the saddle. The saddle is carried up under the roof covering as shown in the broken view at *C* with a lock edge turned. The broken view at *D* shows the continuation of the base flashing with the shingle flashings at the side of the chimney. Where a chimney intersects the ridge of a roof, it is flashed similar to that shown in Fig. 1 on Drawing No. 33.

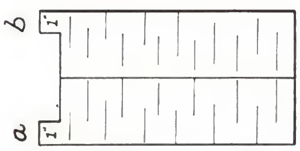


FIG.2 DETAIL OF HIP FLASHING

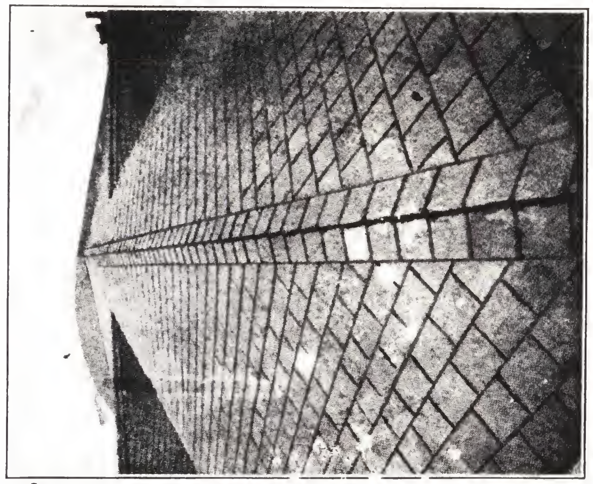


FIG.3 FINISHED VIEW OF HIP COVERED WITH SLATE

SCALE - 1"=1'-0"

FIG.1 METHOD OF APPLYING FLASHING TO HIP COVERED WITH SLATE – ALSO APPLICABLE TO RIDGE

DRAWING NUMBER 34 HIP AND RIDGE FLASHING FOR SLATE OR FLAT TILE ROOFS

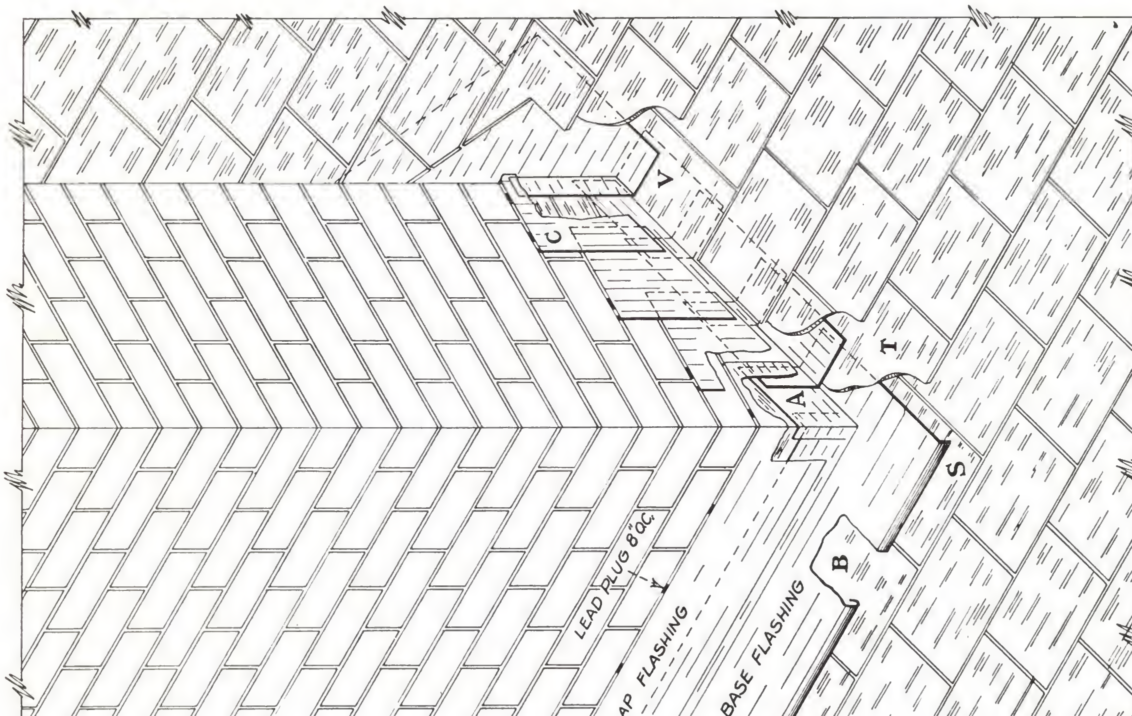


FIG.1 PERSPECTIVE VIEW SHOWING FLASHING AT FRONT AND SIDE OF CHIMNEY FOR SLATE, FLAT TILE AND SHINGLE ROOFS

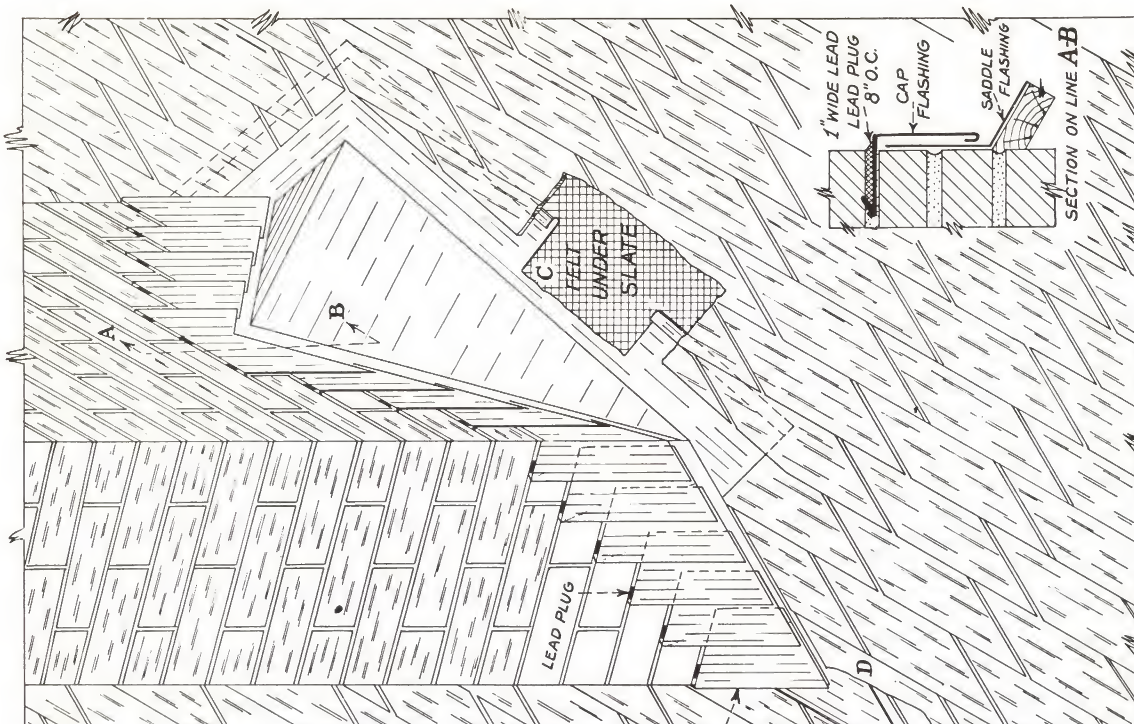


FIG.2 PERSPECTIVE VIEW SHOWING FLASHING AT SIDE AND REAR OF CHIMNEY FOR SLATE, FLAT TILE AND SHINGLE ROOFS

DRAWING NUMBER 35 CHIMNEY AND SADDLE FLASHING FOR SLATE OR FLAT TILE ROOFS

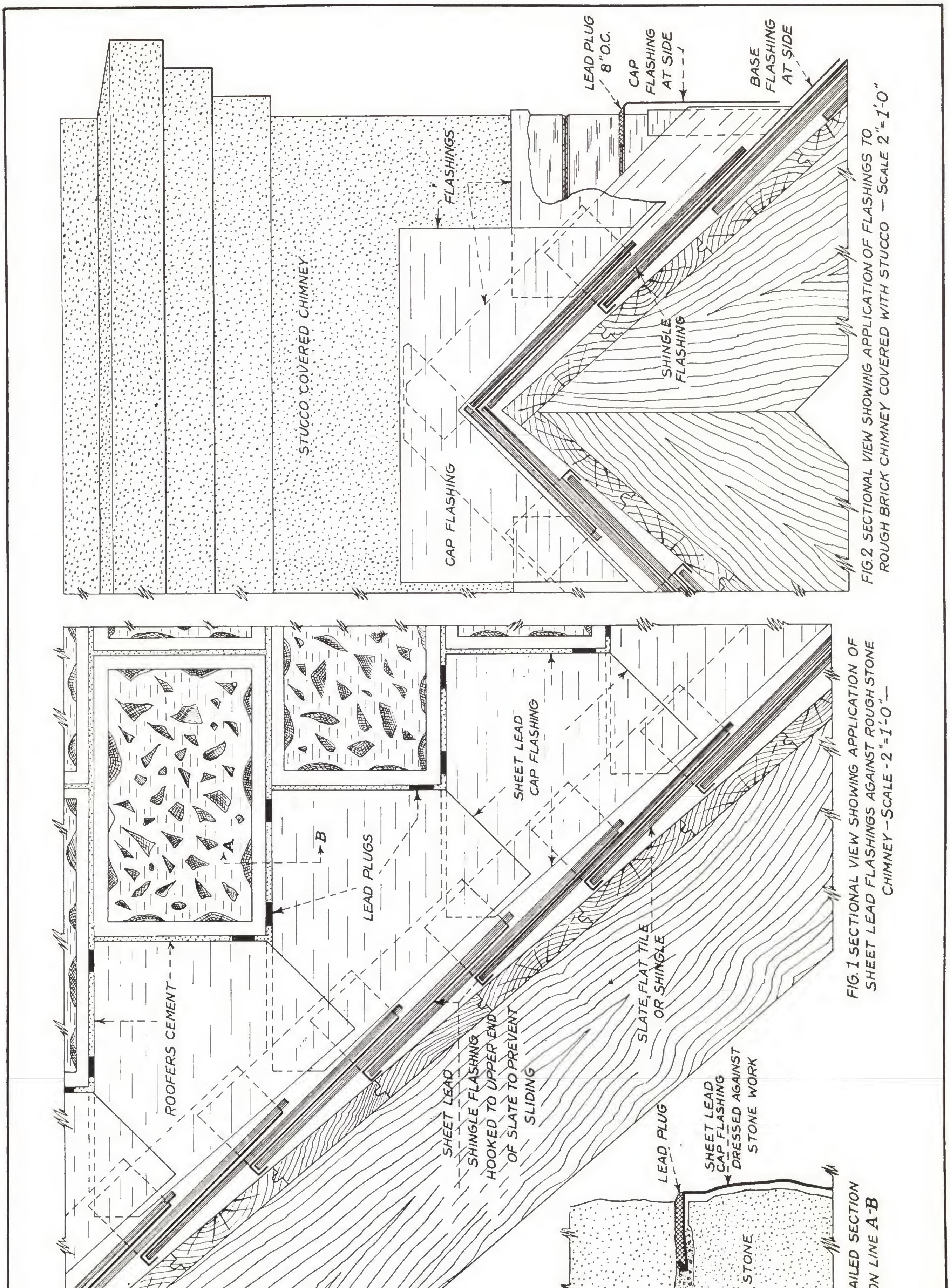


FIG.2 SECTIONAL VIEW SHOWING APPLICATION OF FLASHINGS TO ROUGH BRICK CHIMNEY COVERED WITH STUCCO — SCALE 2"=1'-0"

FIG.1 SECTIONAL VIEW SHOWING APPLICATION OF SHEET LEAD FLASHINGS AGAINST ROUGH STONE CHIMNEY —SCALE -2"=1'-0"—

DRAWING NUMBER 36 FLASHINGS AGAINST RUBBLE STONE AND STUCCO COVERED CHIMNEYS

Flashings Against Rubble Stone and Stucco Covered Chimneys

Drawing No. 36

Two types of chimney construction—one of rubble stone and the other of rough brick covered with stucco—are presented in Drawing No. 36.

On the chimney constructed of rubble stone, sheet lead flashings are used as shown in Fig. 1. As sheet lead is pliable, it can be dressed with ease against the rough stone surface with a mallet.

Note that the sheet lead shingle flashings are hooked over the upper end of the slate as shown and the cap flashings are wedged into the joint not less than $1\frac{1}{2}$ in., plugged with lead every 8 in. and the joint filled with roofers' elastic cement.

A detailed section on the line *A-B* is given in the lower left hand corner. Fig. 2 shows a sectional view and part elevation of a stucco covered chimney intersecting the ridge of the roof. Note how the slate ridge is completed and flashings inserted. The broken view at the lower right shows the base and cap flashings at the side of the chimney.

Dormer Window Flashing at Slate or Flat Tile Roofs

Drawing No. 37

Fig 1 in Drawing No. 37 shows how flashings are applied against a dormer window when the main roof, the roof cheeks and the front of the dormer are covered with slate, flat tile or shingles.

After course *E* is laid on the main roof, the base flashing *F* and shingle flashing *H* are placed, care being taken to solder the lapped corners shown. Over this flashing, course *I* is laid, then the shingle flashing *J*, and so on. Care is taken to hook the shingle flashings *I*, *J*, *K*, etc., over the upper end of the slate as shown in Fig. 2 on Drawing No. 31.

The upper courses of slate slip into a groove formed at the bottom of the cornice, as shown. To cover the nail heads of the finishing course, a cap flashing is placed as described in Fig. 2. Where the slates miter at the corner between the cheek and the front of the dormer, shingle flashings shown by *N* are used over each course of slate at the corner and a similar flashing as shown at *O* is used where the slate abuts the window frame.

Fig. 2 gives a detail through the cornice on the line *A-B* in Fig. 1, and shows the flashing extending up under the slate on the dormer roof. Note how the cap flashing below the cornice is bent, covering the nail heads to avoid leakage. A slight corrugation is formed as shown so that when the cap flashing is pressed between the slate and the metal, it will bind and prevent slipping.

A section on the line *C-D* in Fig. 1 through the sill is shown in Fig. 3. Note how the metal sill is covered, joining the base flashing with a locked drip, which allows for free movement of the metal. To prevent the apron from sliding, cleats are nailed at *A* every 10 or 12 in. and the lower end turned over the hem edge of the apron at the bottom.

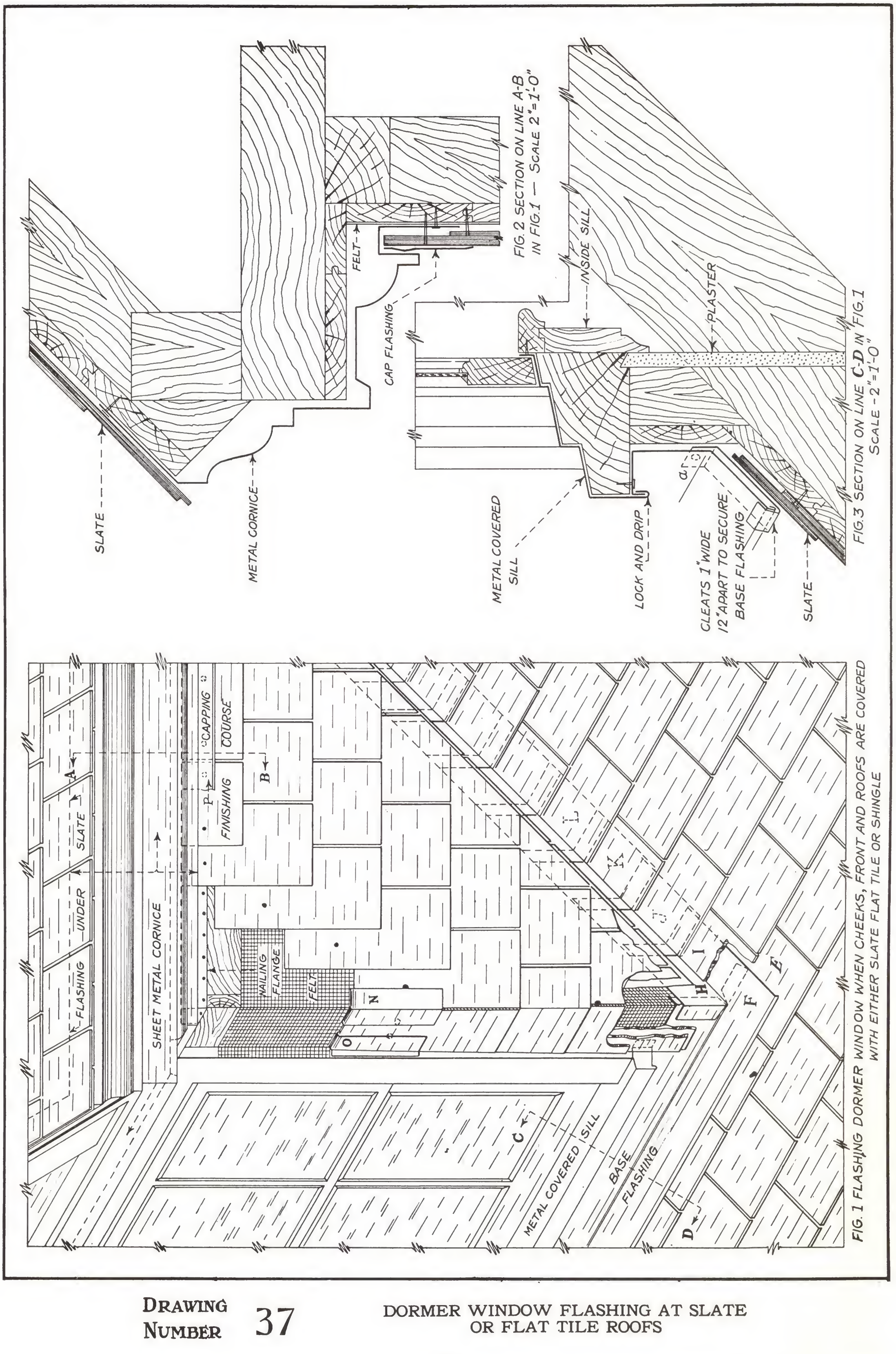
Dormer Window Flashing with Cheeks of Stucco

Drawing No. 38

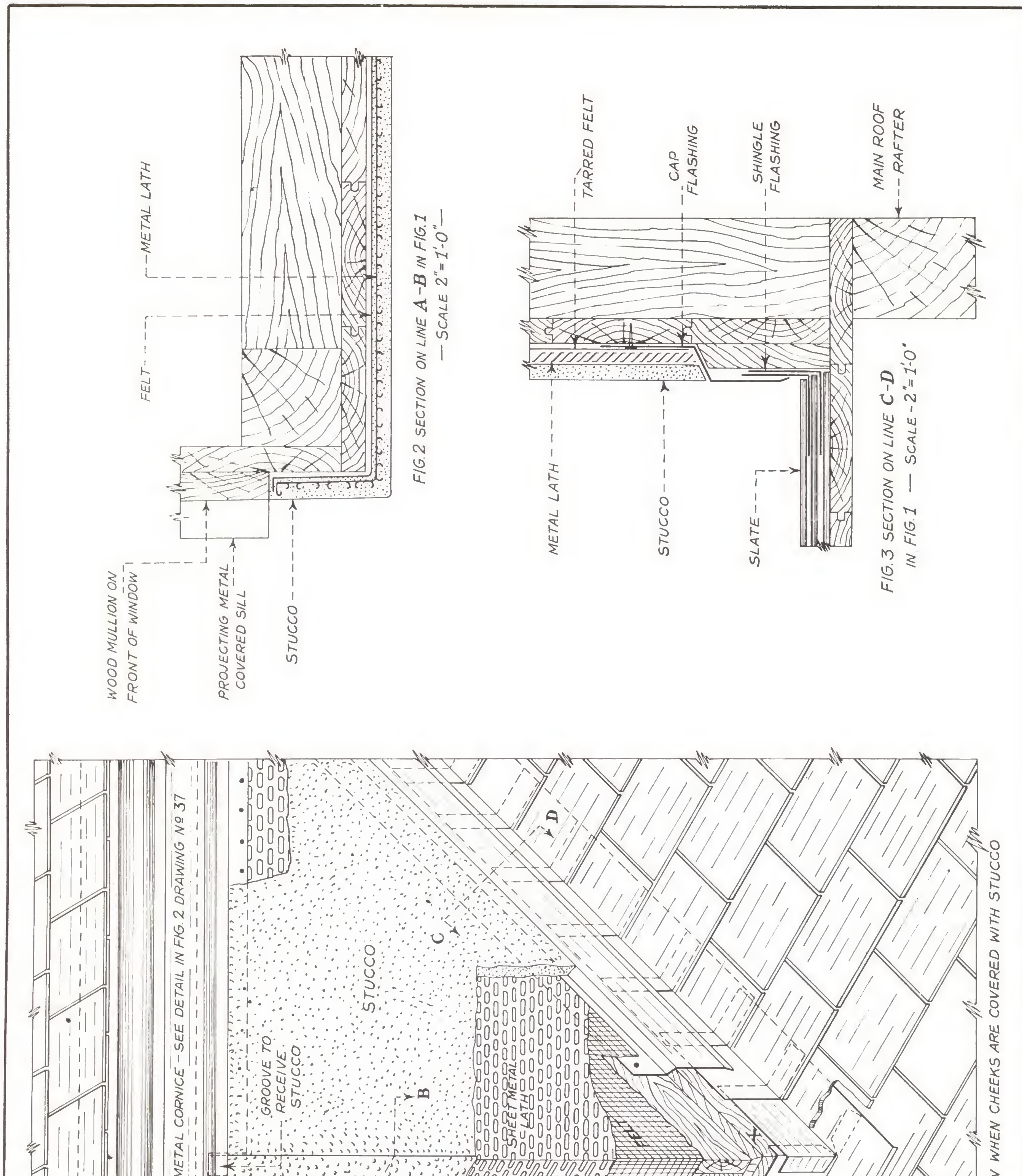
The methods of procedure in flashing a dormer window whose cheeks are covered with stucco, regardless of whether the main roof is covered with slate, flat tile or shingle, are presented in Drawing No. 38. The method of laying the shingle flashings is similar to that described in the preceding drawings.

Provision is made to receive and support the stucco finish at the lower line of the cheeks of the dormer by nailing a projecting board to the dormer cheeks as indicated at *X* and over this the cap flashing is applied as shown. Two ply tarred felt is lapped over the cap flashing, then the metal lath and finally the stucco, finished even at the base as shown, and the stucco pressed well into the groove at the bottom of the cornice as indicated.

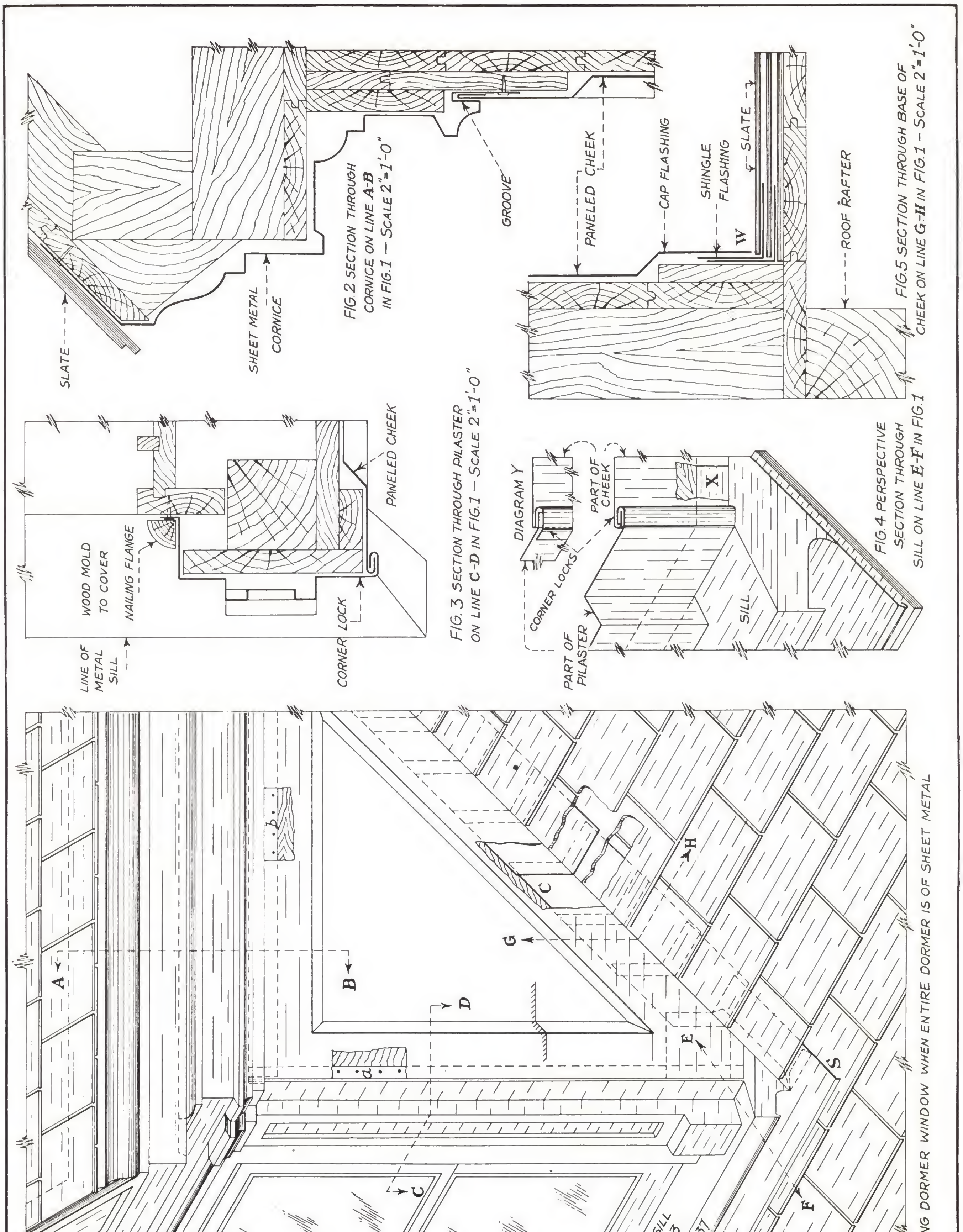
A detailed section on the line *A-B* is shown in Fig. 2, and is self-explanatory. Another section on the line *C-D* in Fig. 1 is shown in Fig. 3.



DRAWING NUMBER 37 DORMER WINDOW FLASHING AT SLATE OR FLAT TILE ROOFS



Drawing Number 38 DORMER WINDOW FLASHING WITH CHEEKS OF STUCCO



DRAWING NUMBER 39 SHEET METAL DORMER WINDOW ON SLATE OR FLAT TILE ROOFS

Sheet Metal Dormer Window on Slate or Flat Tile Roofs

Drawing No. 39

In Drawing No. 39 are shown the methods of erecting the siding and various flashings when the entire dormer is covered with sheet metal.

Fig. 1 shows a perspective view of such a dormer. The entire sheet metal dormer is completed in the shop with sill, pilasters and pediment attached, but without the cornice returns and cheeks. After the slate is laid to course *S*, the dormer is set plumb and true with the sill flashing being set over course *S*, and the shingle flashing soldered in place as indicated by the dotted lines at *E*. The flange of the pilaster is nailed as shown at *a* and when the cornice returns are soldered in position, the flange of the cornice is nailed as at *b*.

The roof is laid with shingle flashings inserted between courses of slate as shown in the broken view at *C*. The paneled cheeks are set last, the vertical corners being locked with a double seam or Pittsburgh lock and the upper part of the cheek inserted in a groove provided at the bottom of the cornice, as shown in the following detail.

A detail on the line *A-B* in Fig. 1 through the cornice is given in Fig. 2. A section through the pilaster on the line *C-D* in Fig. 1 is shown in Fig. 3. Note the construction of the corner lock between the pilaster and paneled cheek. Before this lock is turned over, the seam is filled with white lead.

Note in Fig. 4 that the lock overlaps the flashing *X*. A Pittsburgh lock is shown in Diagram *Y* above.

A section through the base of the cheek on the line *G-H* is shown in Fig. 5. Note that the base *W* acts as a cap flashing over the shingle flashings and slate.

Gable Wall Flashing on Slate or Tile Roofs

Drawing No. 40

Drawing No. 40 shows how flashings are laid against gable walls with various kinds of roof covering. In Fig. 1 is shown the method of applying shingle and cap flashings when the roofing is of slate, flat tile or shingles. The drawing is self-explanatory.

Care is taken to obtain a tight joint where the gutter flashing joins at the corner marked *X*. All shingle flashings are hooked over the upper end of slate, as shown on the last course marked *Y*.

If the cap flashing is not built in the wall as the masonry progresses, the joint is dug out not less than $1\frac{1}{2}$ in. and the cap flashing inserted with an upturned edge, which is secured to the brick joint with lead plugs about 1 in. wide and the full depth of $1\frac{1}{2}$ in. The cap flashing at the lower corner is double locked and soldered as shown more clearly in the section through *A-B* at the bottom of Fig. 1.

Fig. 2 shows the combination base flashing and valley used in connection with Spanish tile roofing. This base flashing *A* is covered with stepped cap flashings secured in a manner just described and shown at *B*.

A one-quarter full size detail of the base flashing and valley is shown in Fig. 3.

Wall Flashings on Slate or Tile Roofs

Drawing No. 41

The methods of applying cap and base flashings in connection with various roof coverings are presented in Drawing No. 41.

Fig. 1 shows the method when the wall is of rubble stone and the cap flashing covers the entire wall to avoid seepage. The wall is started with brick, to form a level base for the flashing, which covers the entire wall and makes a pan which acts as a complete cut-off for water penetrating the wall.

To prevent the base flashing from slipping down, cleats about 1 in. wide are nailed to the brick wall as shown at *A*, spaced about 12 in. apart to suit the vertical joints in the brick work. After the base flashing is inserted, the lower end of the cleat is turned over the flashing shown at *B*.

Fig. 2 shows a Spanish tile roof abutting a wall. In this case, the cap flashing extends in the wall the width of a brick with an upturned flange of 1 in. as shown. After the tiles are laid on felt and the tile top fixture *X* is in position, the cleat is nailed to the brick joint, the base flashing slipped under the cap flashing and the lower end of the cleat *C* turned over as at *D*.

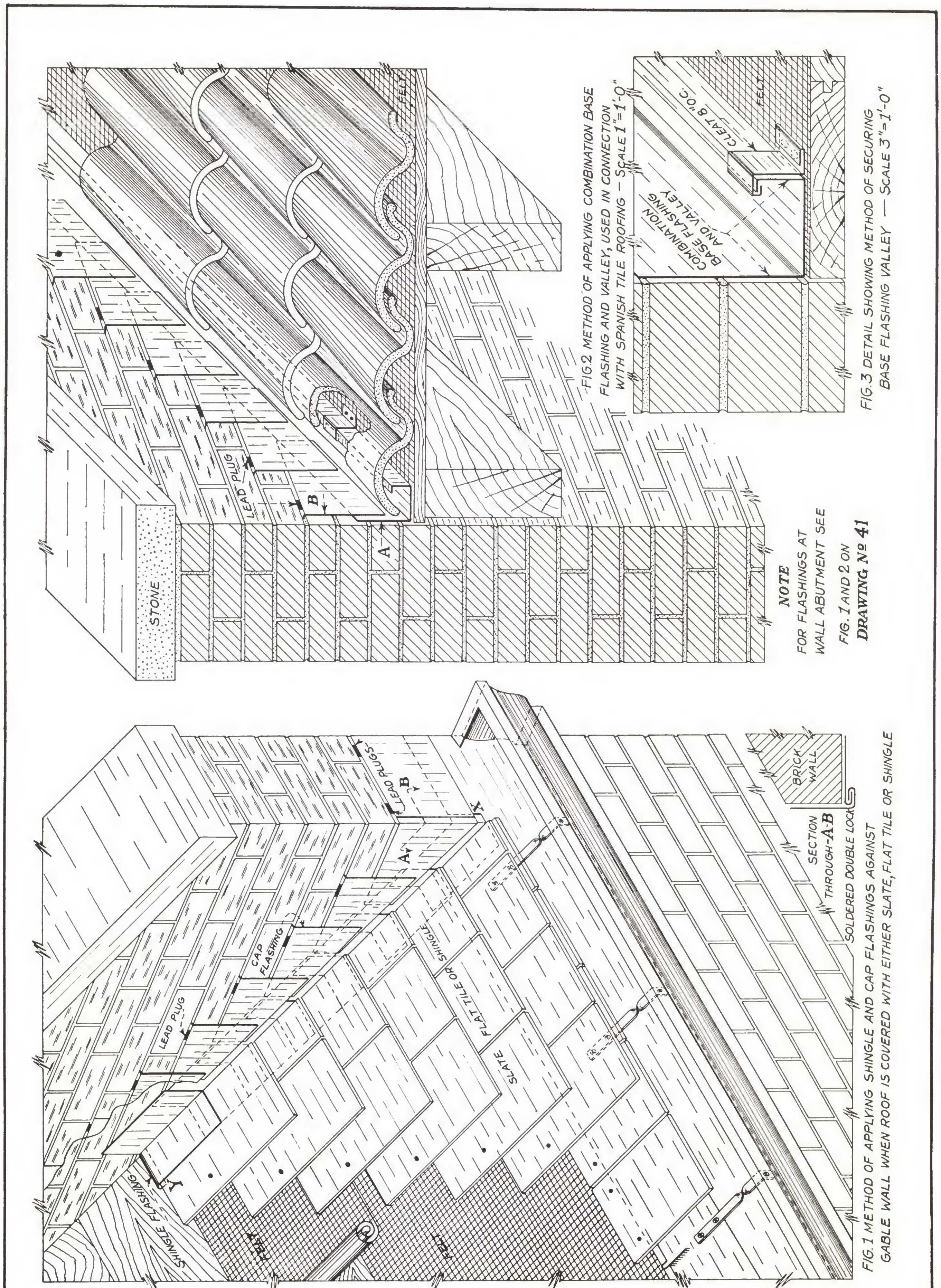


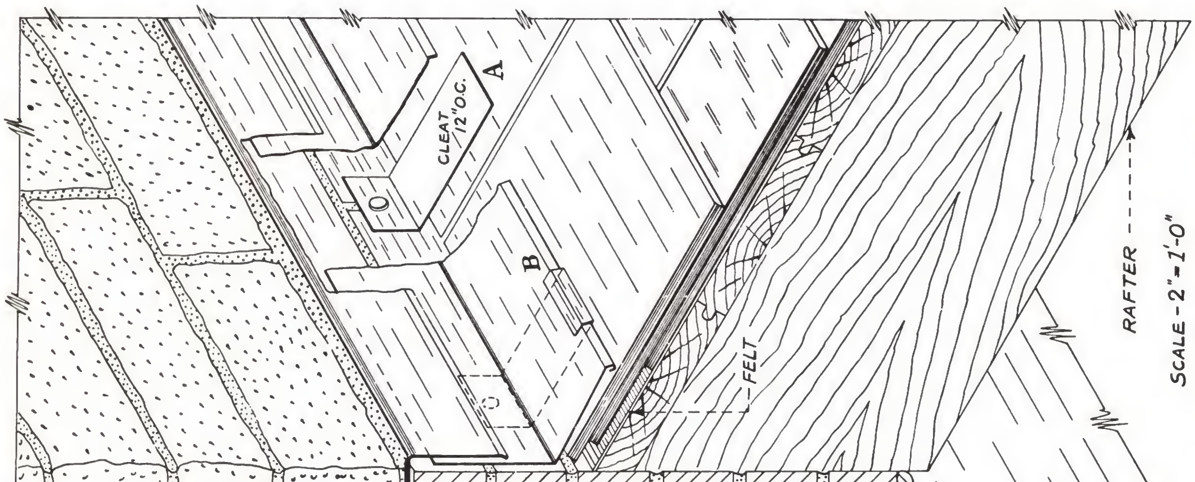
FIG.1 METHOD OF APPLYING SHINGLE AND CAP FLASHINGS AGAINST GABLE WALL WHEN ROOF IS COVERED WITH EITHER SLATE, FLAT TILE OR SHINGLE

FIG.2 METHOD OF APPLYING COMBINATION BASE FLASHING AND VALLEY, USED IN CONNECTION WITH SPANISH TILE ROOFING — SCALE 1"=1'-0"

FIG.3 DETAIL SHOWING METHOD OF SECURING BASE FLASHING VALLEY — SCALE 3"=1'-0"

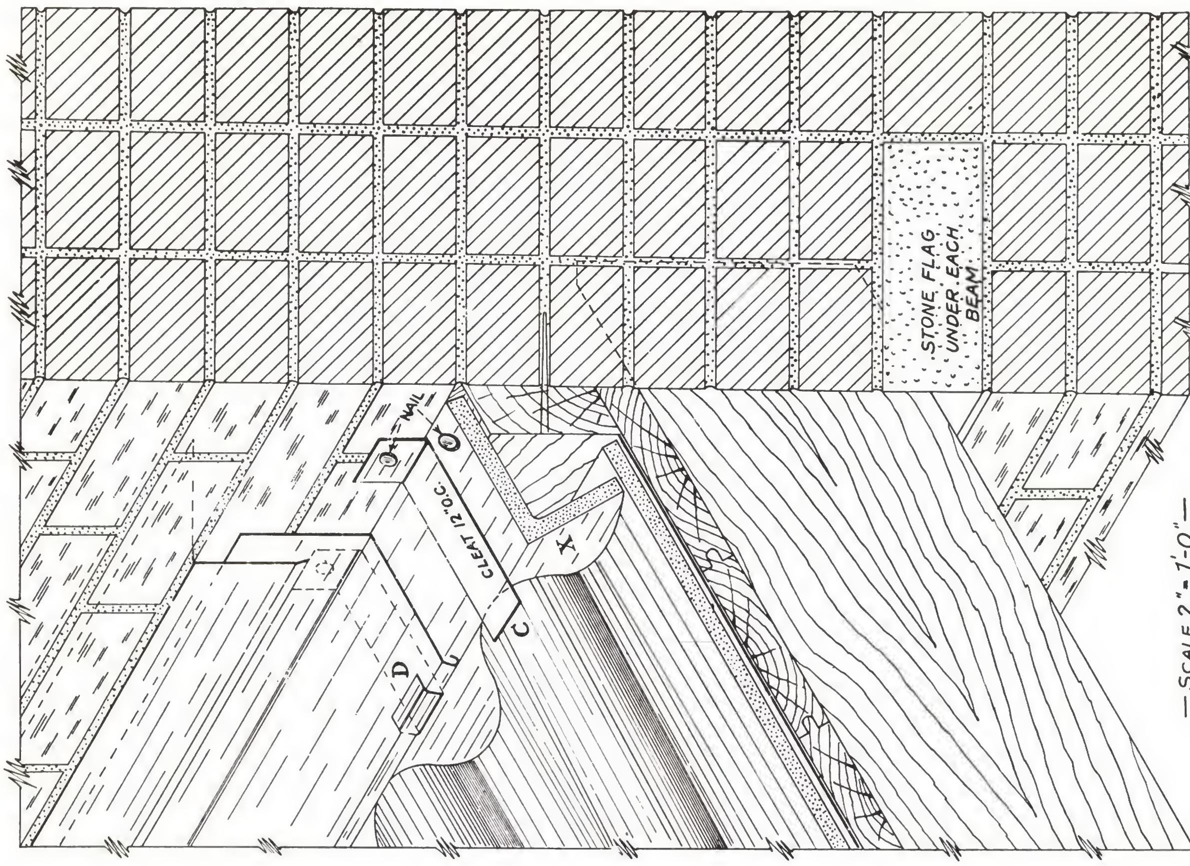
NOTE
FOR FLASHINGS AT WALL ABUTMENT SEE FIG. 1 AND 2 ON **DRAWING Nº 41**

DRAWING NUMBER 40 GABLE WALL FLASHING ON SLATE OR TILE ROOFS



SCALE - 2" = 1'-0"

FIG. 1 METHOD OF APPLYING CAP AND BASE FLASHINGS AT WALL ABUTMENT IN CONNECTION WITH RUBBLE WALL FOR SLATE, FLAT TILE OR SHINGLE ROOF



— SCALE 2" = 1'-0" —

FIG. 2 METHOD OF APPLYING CAP AND BASE FLASHINGS AT WALL ABUTMENT IN CONNECTION WITH BRICK WALL AND SPANISH TILE ROOF

DRAWING NUMBER 41 — WALL FLASHINGS ON SLATE OR TILE ROOFS

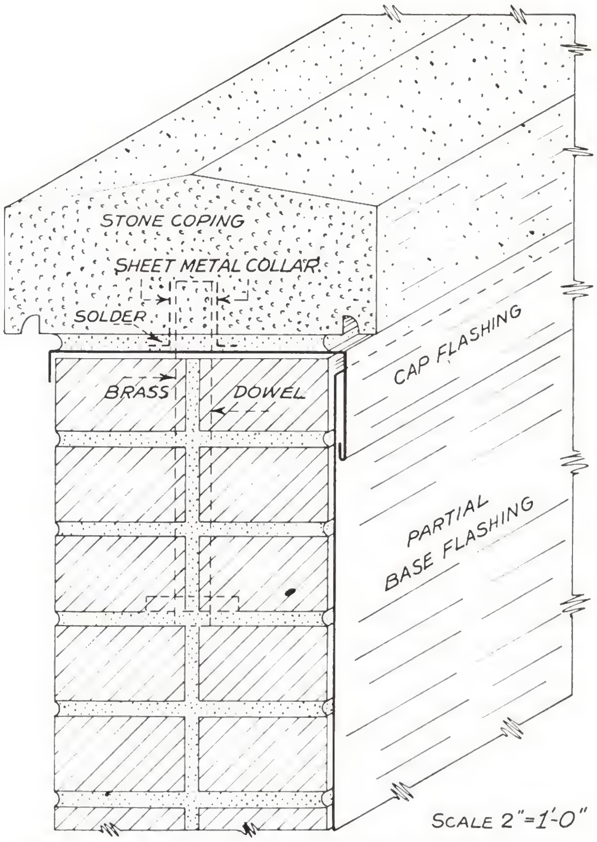


FIG. 1 METHOD OF FLASHING A BRICK PARAPET WALL NOT OVER 16 IN. ABOVE ROOF LINE—CAP FLASHING TO COVER FULL WIDTH OF WALL UNDER COPING

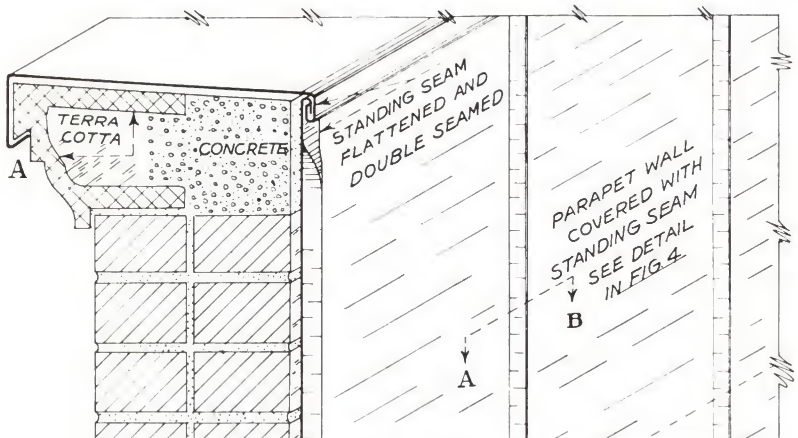


FIG. 3 FLASHING BRICK PARAPET WALL AND TERRA COTTA COPING WHEN WALL IS OVER 16" ABOVE ROOF LINE   SCALE - 1½"= 1'-0"

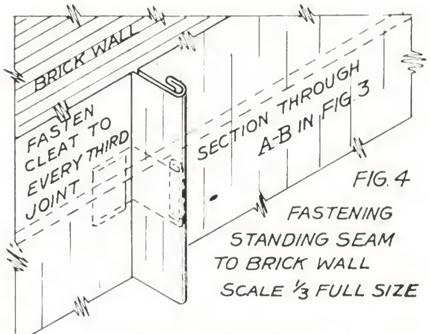


FIG. 4 FASTENING STANDING SEAM TO BRICK WALL SCALE ⅓ FULL SIZE

FIG. 5 FLASHING COPING JOINT TO PREVENT SEEPAGE OF WATER

DRAWING NUMBER 42   PARAPET WALL FLASHING

Parapet Wall Flashing

Drawing No. 42

Three methods of protecting parapet walls against seepage of water are given in Drawing No. 42.

Fig. 1 shows the entire wall covered with sheet metal under the coping. Note that dowels are built into the wall and around each dowel a flanged collar is soldered. When the wall is not more than 16 inches above the roof line, flat base flashing is slipped under the cap flashing.

When the wall is more than 16 inches above the roof line and the entire surface is to be covered, the standing seam method is used as shown in Fig. 3. Note that the metal hooks under the drip at A. In this case the standing seam covering also acts as a cap flashing overlapping the base flashing not less than 3½ inches.

Fig. 4 is a section through *A-B* in Fig. 3. Fig. 5 shows the method of preventing seepage through the coping joints by inserting a pan flashing under each joint. *A-B-C* shows the shape of the flashing, turned down about 1 in. on each side of the wall with a ⅜-in. upturned edge at *a-b* to receive the seepage and allow it to drain to the face of wall at *A* and *B*.

Deck Molding and Flashing at Mansard Roof

Drawing No. 45

Three types of connections between mansard and deck roofs are presented in Drawing No. 45.

Fig. 1 shows the method of making a water-tight connection between a mansard roof covered with slate, tile or shingles and a deck roof covered with composition roofing. The finish at the intersection is made with a sheet metal deck cornice around the four sides of the roof in which a box gutter is formed, the water being drained to inside cast iron drain pipes. Care is required in setting the deck cornice to obtain a storm-proof joint *A* where the metal mold fits snugly against the slate.

After the last course of slate is laid, clamps indicated at *B*, are screwed to the sheathing spaced about 30 in. apart. The lower leg of the clamp is not more than ⅛ in. above the slate line, so that when the lower flange of the metal cornice is hooked between the clamp and slate, the cornice is in a level position to secure the braces with anchor nails as shown at *C*. The gutter is locked to the projecting edge at *E* and turned up flush with the roof line as shown at *F*.

As the deck roof in this case is of gravel, slag or flat tile, a combination cap flashing and gravel stop is nailed over the felt and the gravel, slag or flat tile roof is laid in the usual manner.

Fig. 2 shows a sectional view of a mansard roof covered with Spanish tile connecting to a metal covered deck roof and the ridge finished with a tile ridge roll.

Another type of finish at the ridge is given in Fig. 3. A wood ledge is nailed at the ridge line against which the slating stops and the metal roofing flashes against this ledge as shown. The base of the cresting is formed in one piece and acts as a cap flashing over the metal and slate roofs, all as shown.

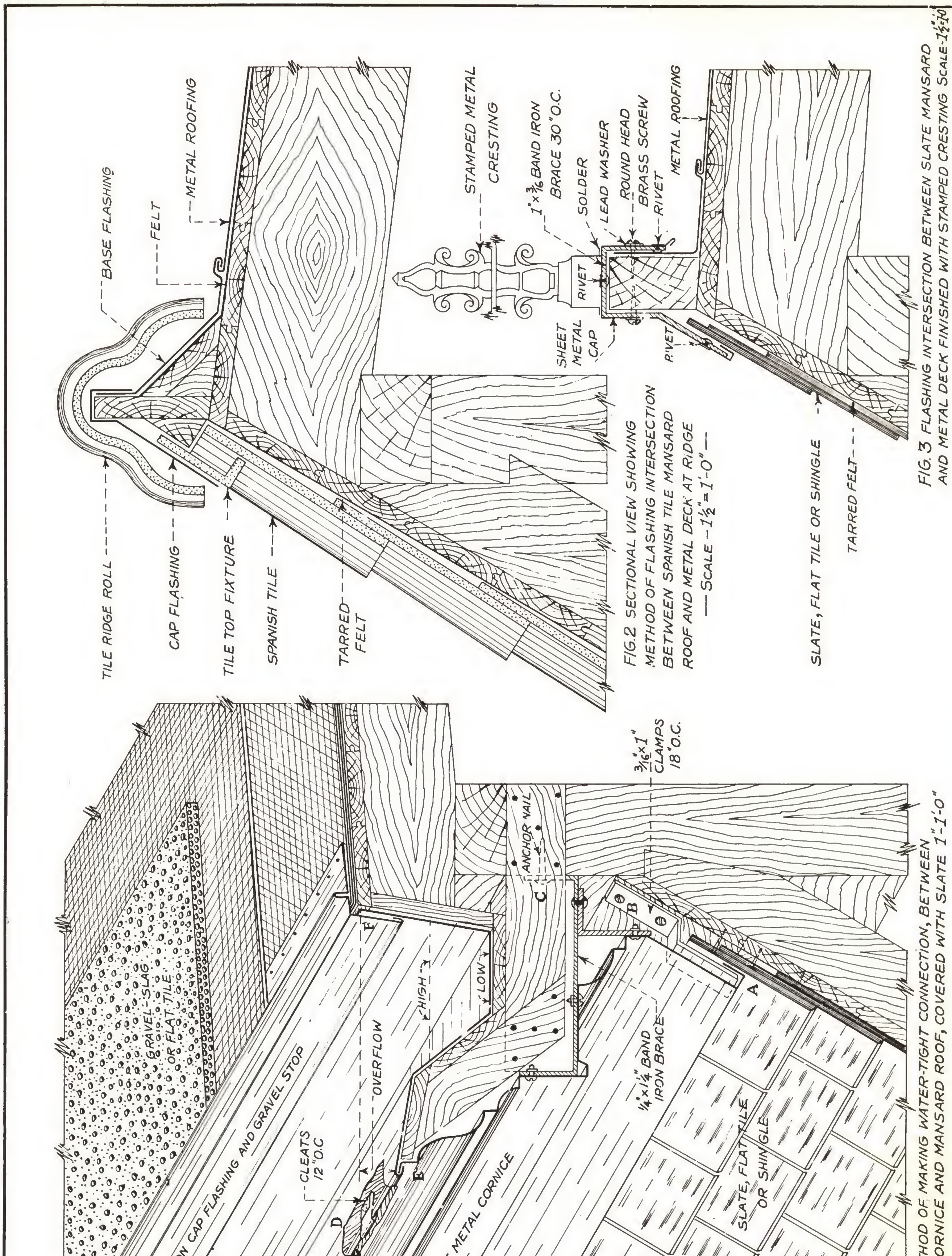


FIG. 1 METHOD OF MAKING WATER-TIGHT CONNECTION, BETWEEN DECK CORNICE AND MANSARD ROOF, COVERED WITH SLATE 1"-1'-0"

FIG. 2 SECTIONAL VIEW SHOWING METHOD OF FLASHING INTERSECTION BETWEEN SPANISH TILE MANSARD ROOF AND METAL DECK AT RIDGE — SCALE — 1 1/2" = 1'-0" —

FIG. 3 FLASHING INTERSECTION BETWEEN SLATE MANSARD AND METAL DECK FINISHED WITH STAMPED CRESTING SCALE - 1 1/2" = 1'-0"

DRAWING NUMBER 45 DECK MOLDING AND FLASHING AT MANSARD ROOF

Saw Tooth Roof—Ridge Mold and Flashing

Drawings No. 48-48A

The method of making water-tight connections at ridges of saw tooth roofs covered with slate, flat tile or shingles and with either slate, flat tile, shingle or corrugated sheet iron sidings, is shown in Drawing No. 48.

Fig. 1 shows the procedure when the window frames and sash are of wood, the siding covered with corrugated sheet iron and the roof covered with either slate, flat tile or shingles. The head of the window is flashed first, as shown by *A-B*. *A* extends up not less than 4 in. and *B* forms a drip. At the ridge of the roof blocking is nailed as indicated by *C* and *D*. The width of the blocking *C* is 1/8 in. more than the thickness of three slate.

After the slate is laid, the sheet metal ridge cap is placed in position, being nailed below the groove *H*, which receives the corrugated sheets. At the top roof line the hem edge *E* is pressed firmly to the slate and secured with nails every 18 in. This holds down the flanges close to the slate line at *E*. When the ridge capping is in place, the corrugated siding is slipped into the groove *H* and nailed in the usual manner.

If a more elaborate finish is desired at the ridge, the capping is molded as indicated in Fig. 2. When both siding and roof are to be covered with slate, flat tile or shingles and the window frames and sash are of hollow metal, the method of flashing is indicated as in Fig. 3. Here the flashing *X* and drip *Y* are formed directly to the hollow metal frame. The blockings *A* and *B* on the siding and *C* and *D* on the roof are nailed in position.

The siding and roofing slate are now laid in the usual manner, finished against the block. Over the slate the sheet metal ridge mold is secured with nails as shown by *a* and *b*. When nailing the hem edged flanges *E* and *F*, they are pressed against the slate line.

Drawing No. 48A shows how the curb and sill of a monitor saw tooth front is flashed to composition roofing regardless of whether the sash and frame of monitor are of hollow metal or wood.

Fig. 4 presents the construction details when the frame and sash are of wood. The base flashing used in connection with the slag roof is set in the usual manner as indicated. The wood sill is metal covered, nailed at *A* on the outside and at *B* on the inside. After the sill is set, the cap flashing *X* is turned up and nailed behind the sill at *C*. On the inside of the lower part of the wood sash, a condensation gutter is attached as shown, with the metal tubes passing through the sash.

Fig. 5 shows one-half full size section of the condensation gutter and tube which clearly indicates the construction. In Fig. 6 is shown the construction when the sash, frame and sill are made of metal. Note the combination sill and cap flashing. This sill may be made of heavy metal but if light metal is used, it is filled with concrete as indicated. If the base flashing is of copper and the sill of galvanized iron, then both metals receive two heavy coats of asphaltum before erecting, so as to avoid galvanic action. On the lower part of the hollow metal sash, a gutter may be formed as shown to take care of the condensation which is conveyed to the outside by means of the condensation tubes.

The construction shown here is for a stationary sash. Both Fig. 4 and 6 are drawn to a scale of 2 in. to the foot.

Eaves and Verge Finish for Metal Roofs

Drawing No. 51

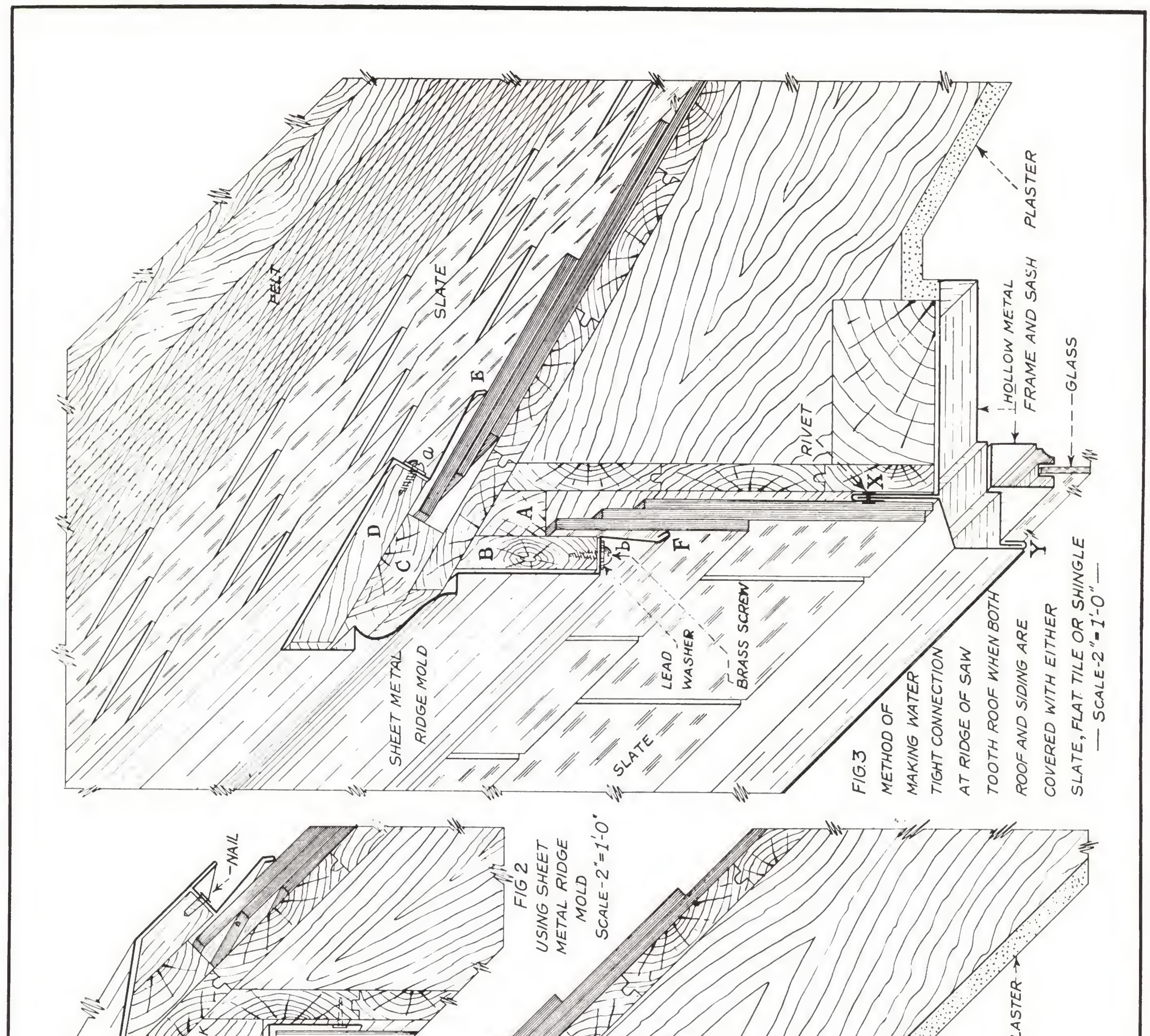
Drawing No. 51 shows ten types of eaves and verge finish for metal roofs, regardless of the kind of sheet metal used.

In Fig. 1 is shown the metal bent under the roof boards, with a lock edge at the top, which is secured to the sheathing by cleats spaced 8 in. apart, as indicated. Each cleat is secured by two barbed wire nails and the end of the cleat is turned over to cover the nail heads. The cleats are used on all of the types presented.

Fig. 2 shows how a drip is formed by two angles, the lower angle being secured by nailing 12 in. apart as indicated by *a* and *b*. Another drip made from one piece of metal is shown in Fig. 3. In Fig. 4 is shown the roof lock, hooked to the projecting edge of the angle strip which forms a drip, and Fig. 5 gives another type of eaves drip.

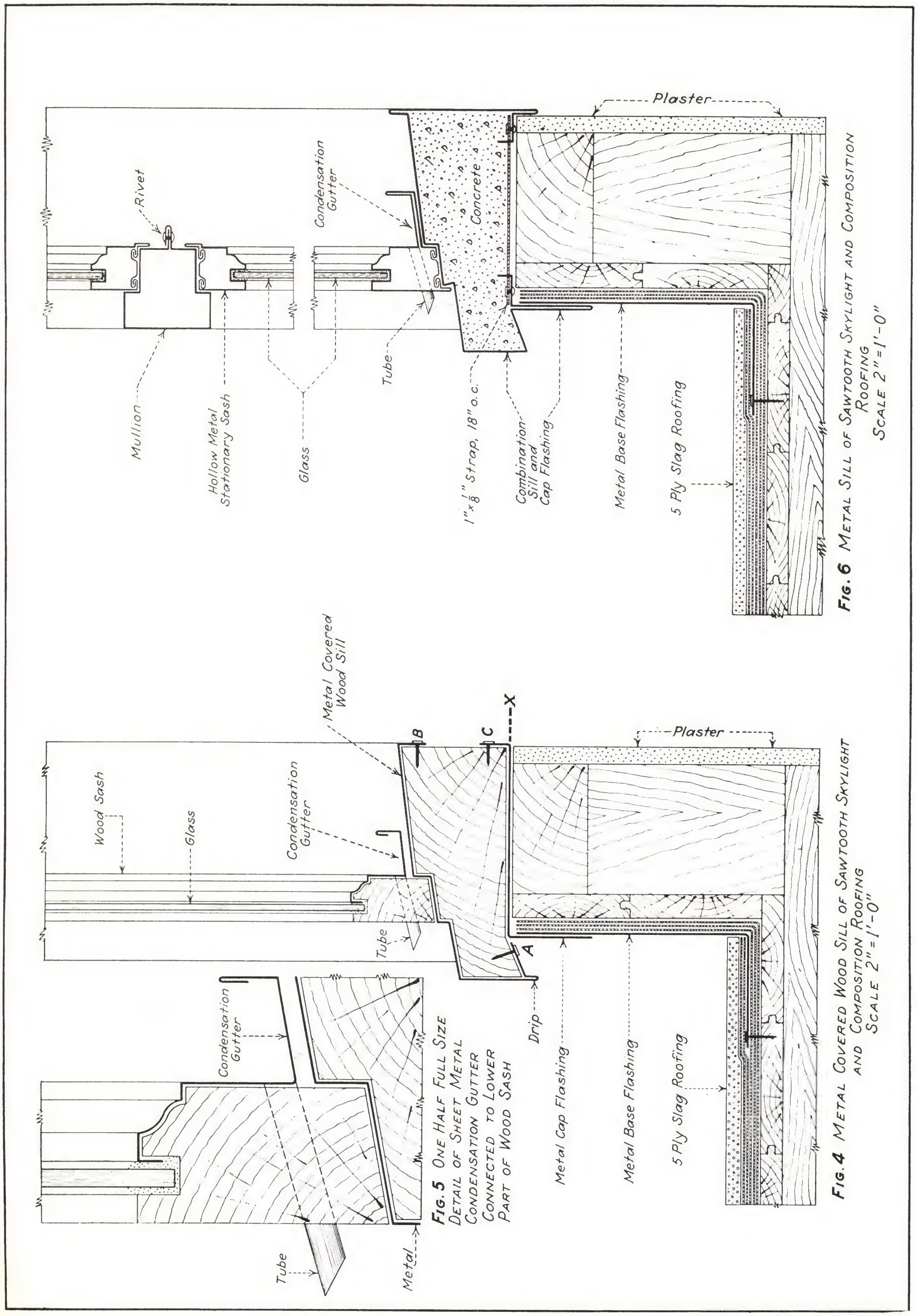
The two operations required in forming the double-seamed edge at the eaves line are presented in Fig. 6 and 6A, while Fig. 7 indicates a molding under the eaves, which forms a drip on the underside of a projecting roof with molded rafters. The construction of a drip and mold on the underside of eaves in connection with a stucco wall is shown in Fig. 8. Fig. 9 is a similar drip and mold showing the construction at the verge, also in connection with a stucco wall.

Another type of verge construction in connection with a brick wall is shown in Fig. 10.



DRAWING NUMBER 48

SAW TOOTH ROOF -- RIDGE MOLD AND FLASHING



DRAWING NUMBER 48A

SAW TOOTH ROOF -- SASH AND CURB CONSTRUCTION

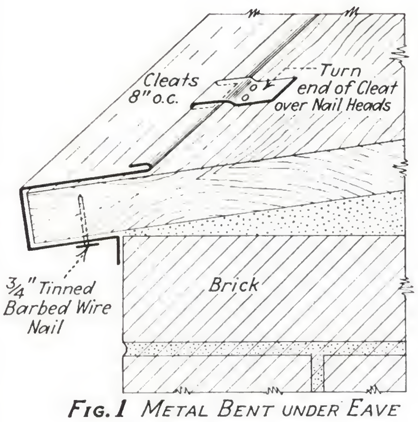


Fig. 1 Metal Bent under Eave

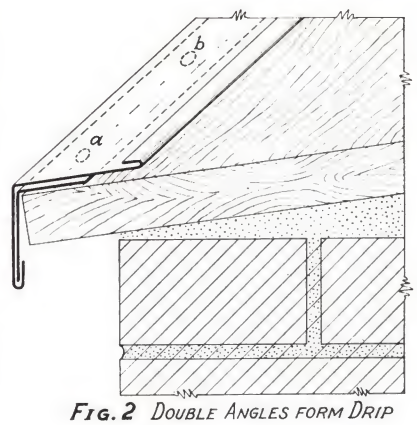


Fig. 2 Double Angles form Drip

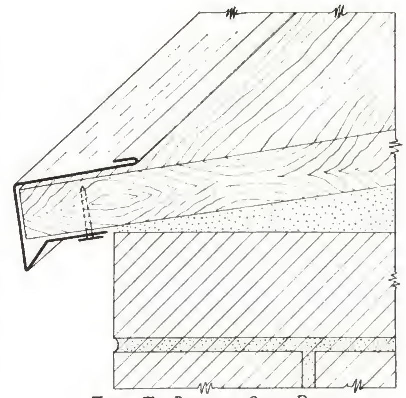


Fig. 3 Drip in One Piece

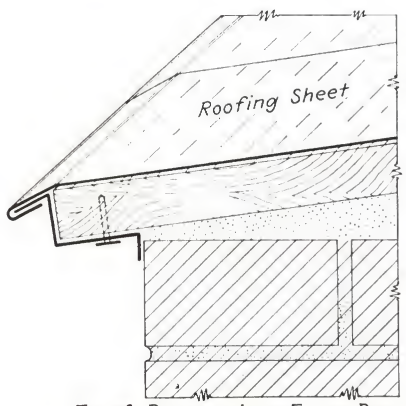


Fig. 4 Roofing Lock Forms Drip

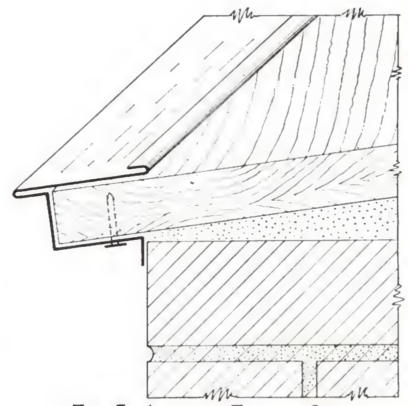


Fig. 5 Another Type of Drip

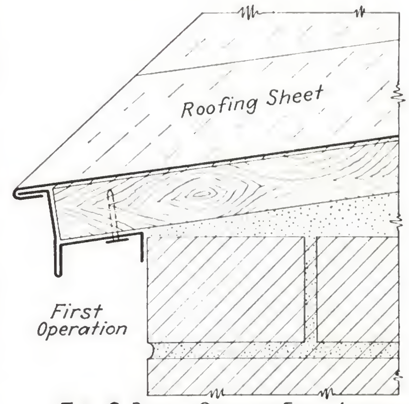


Fig. 6 Doubl Seam at Eave, Locked

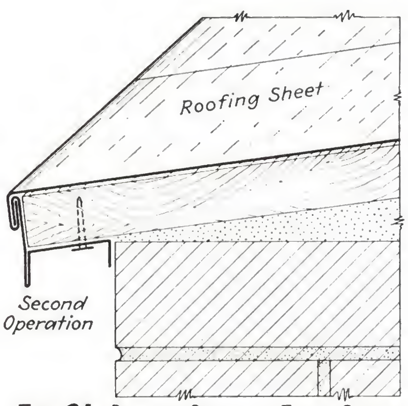


Fig. 6A Double Seam at Eave, Closed

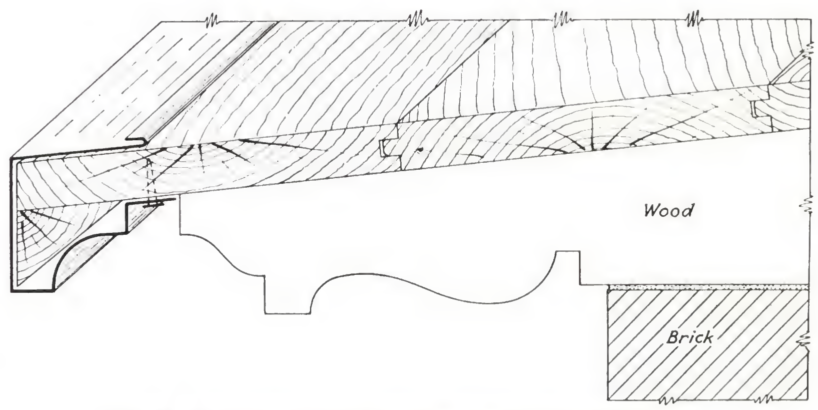


Fig. 7 Molding under Eave with Projecting Rafter

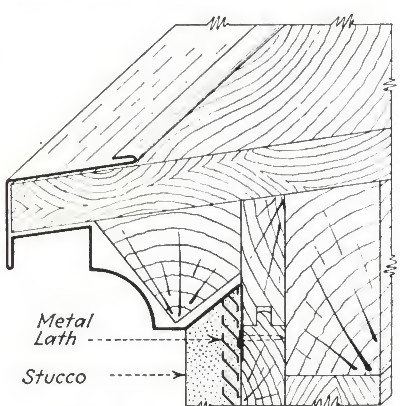


Fig. 8 Molding under Eave to Stucco Wall

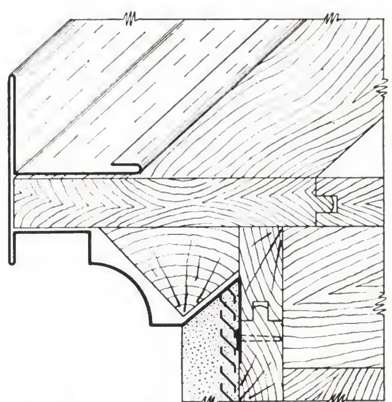


Fig. 9 Showing Verge Construction

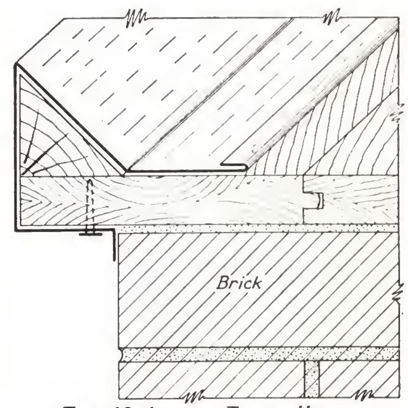


Fig. 10 Another Type of Verge Construction

Scale 3" = 1'-0"

Drawing Number 51

EAVES AND VERGE FINISH FOR METAL ROOFS

Base and Cap Flashings to Walls of Various Construction

Drawings No. 52-52A

Four methods of joining base and cap flashings to brick, stone and concrete walls are shown in Drawing No. 52, and four ways of joining base and cap flashings to stucco, wood and terra cotta walls are given in Drawing No. 52A. The methods presented allow for the expansion and contraction of the metal.

Fig. 1, Drawing No. 52, shows how the base and cap flashings are applied to the brick wall. The cap flashing is built in the wall as the masonry progresses, a 1-in. edge turned up as indicated by *A*, making the distance *A* to *B* equal to the width of bricks used, and turned down at *B* not less than 3½ in. The height of the base flashing is not less than 8 in. and the flange on the roof is determined by the width of the sheets used. The lock edge on the roof is secured to the sheathing with cleats spaced not more than 8 in. apart, with the end of the cleat turned over the nail heads.

When there is danger of leakage through the coping and brick joints, causing dampness on the inside of the walls, the difficulty is overcome by extending the cap flashing through the wall as indicated in Fig. 2, where upright ridges 1 in. high are spaced to fit mortar joints forming a good bond. An outside edge is turned down as indicated by *C*.

With parapet walls of stone, a mortar joint is seldom in the correct position for the building in of a cap flashing, the joint being either too high or too low. For this reason a raggle is cut in the stone wall as shown by *A* in Fig. 3, into which the cap flashing (bent as indicated in the section) is inserted and secured with small lead plugs about 1 in. wide spaced 12 in. apart. These lead plugs hold the cap flashing firmly, after which the raggle is filled with lead wool or with elastic cement. When the parapet walls are of concrete, provision is made for a raggle, by the use of a galvanized or copper sheet metal raggle mold, carefully set before the concrete is poured as indicated in Fig. 4. When the forms are removed, the result is a clean smooth metal raggle, to which the cap flashing is secured as described in connection with Fig. 3.

Fig. 5, Drawing No. 52A, shows how the connections are made with flashings between a flat roof and an adjoining vertical stucco wall, regardless of whether the wall base is of wood, brick or terra cotta blocks. After the height of the base flashing is determined, the wood strip *X* is nailed in its correct position as shown and the combined stucco stop and cap flashing secured by nailing at intervals *A* and *B*.

Over the upper flange of the cap flashing the building paper and the metal lath are applied, as shown. All stucco work is completed before the base flashing is set. The base flashing is slipped up inside of the lock of the cap flashing, as indicated, and secured to the roof sheathing by cleats spaced 8 in. apart.

If a solid back is desired behind the base flashing, the wood strip *X* is extended down to the roof line as at *a* and *b*. When vertical walls are covered with either slate, shingles or clap boards, the method of procedure is as shown in Fig. 6. Over this base flashing the shingles, slates or clap boards are nailed.

When the flat roof abuts a terra cotta wall, such as a cornice placed over a brick parapet wall, the raggle to receive the flashing flange is usually modeled in the terra cotta blocks before baking, as shown in Fig. 7. Fig. 8 shows how a skylight or other wood curb is flashed.

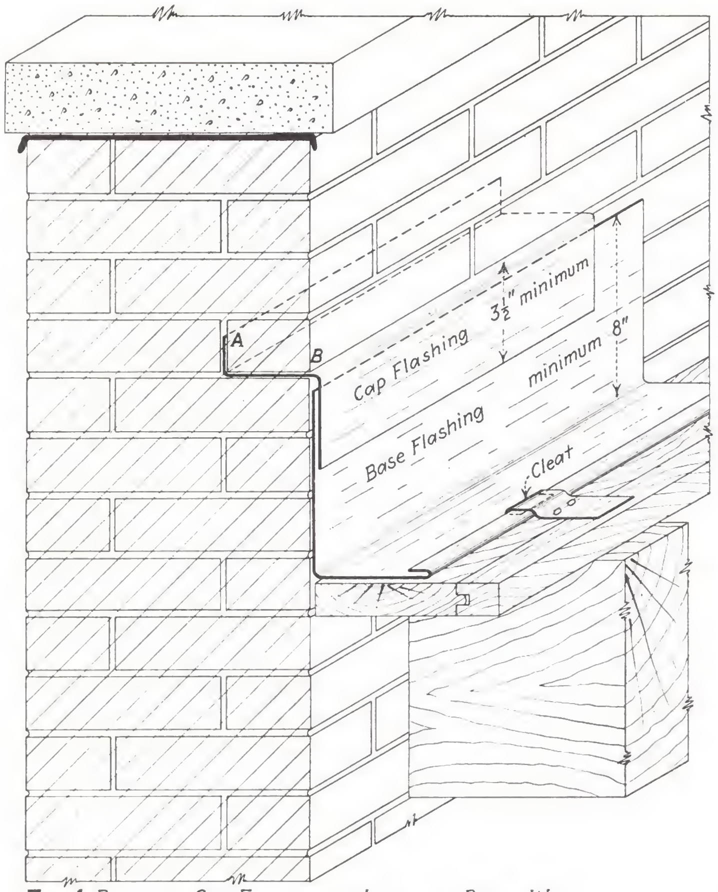


Fig. 1 Base and Cap Flashings Joining a Brick Wall

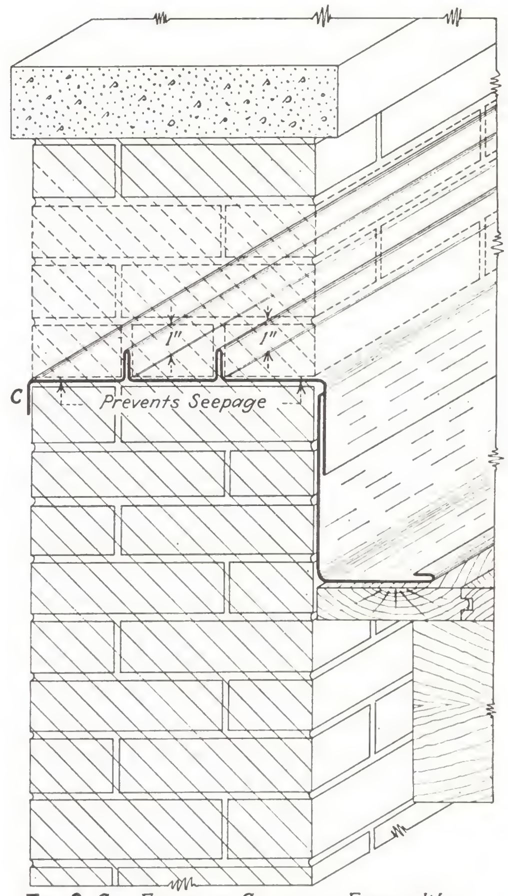


Fig. 2 Cap Flashing Covering Entire Wall

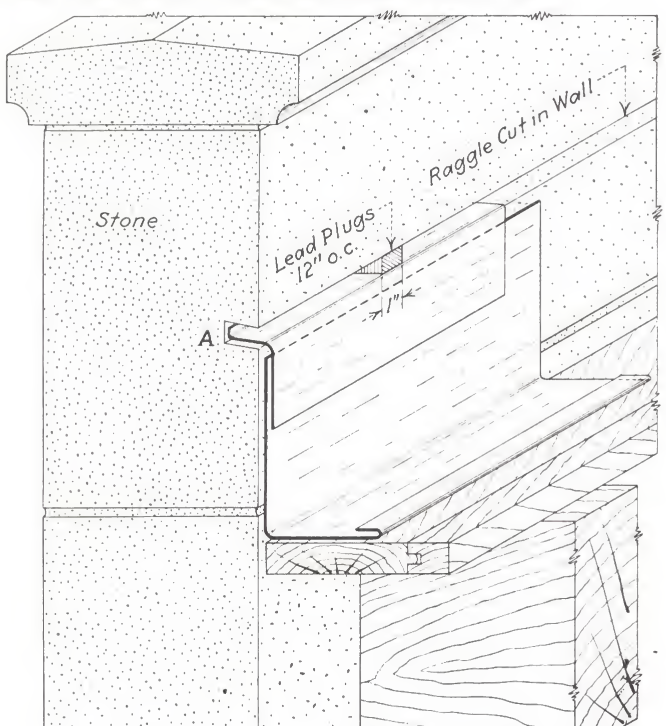


Fig. 3 Base and Cap Flashings Joining a Stone Wall

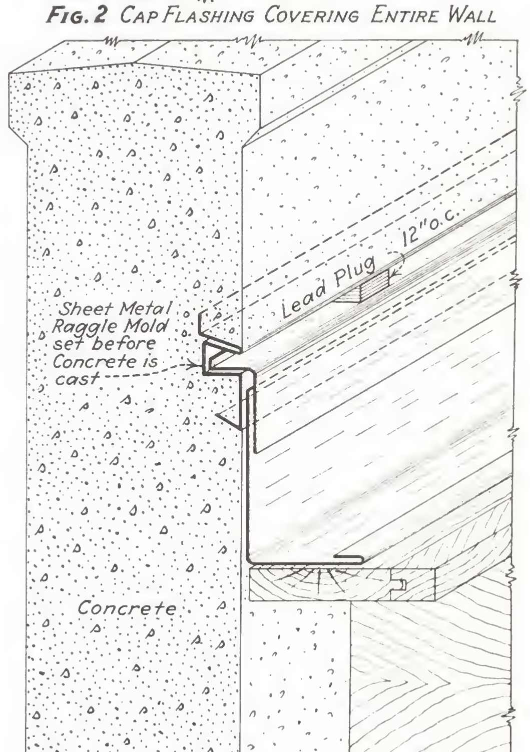


Fig. 4 Base and Cap Flashings Joining Concrete Wall

Scale $1\frac{1}{2}'' = 1'-0''$

Drawing Number 52 — BASE AND CAP FLASHINGS TO WALLS OF VARIOUS CONSTRUCTION

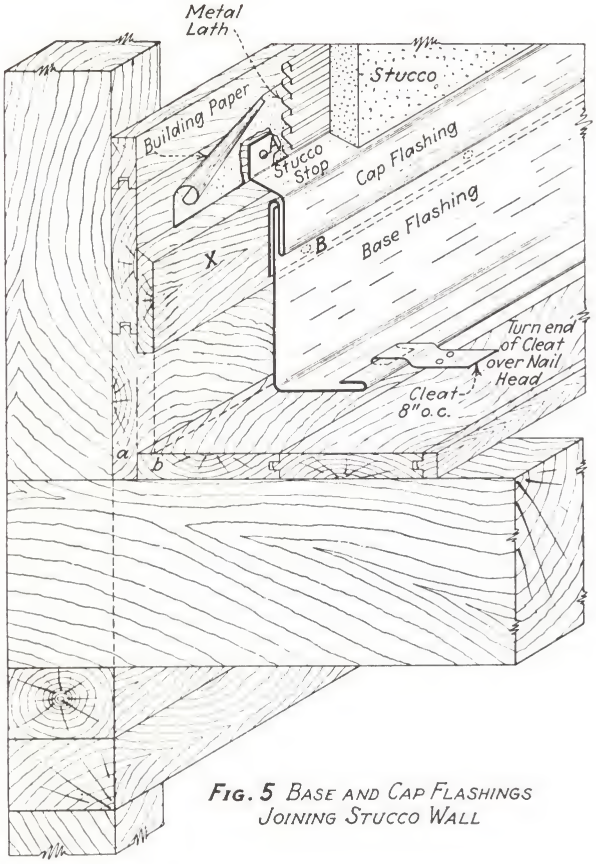


FIG. 5 BASE AND CAP FLASHINGS JOINING STUCCO WALL

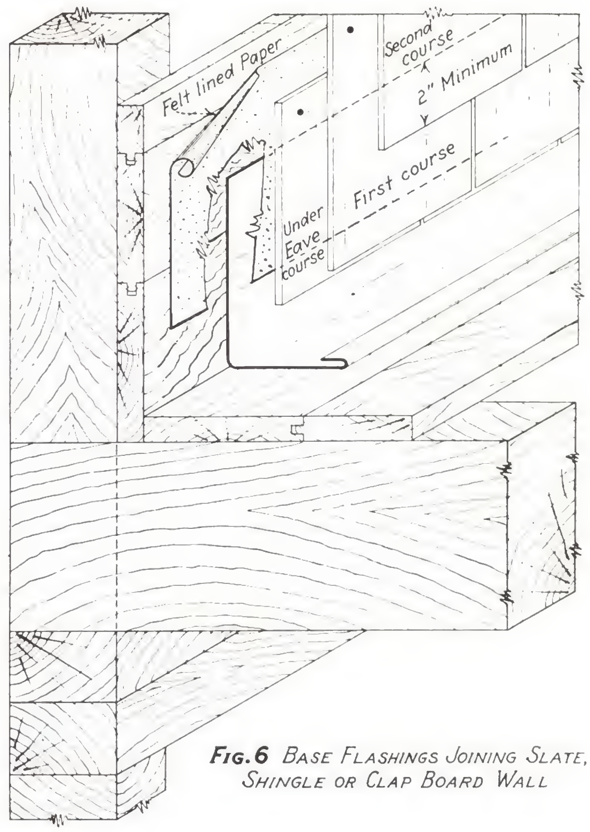


FIG. 6 BASE FLASHINGS JOINING SLATE, SHINGLE OR CLAP BOARD WALL

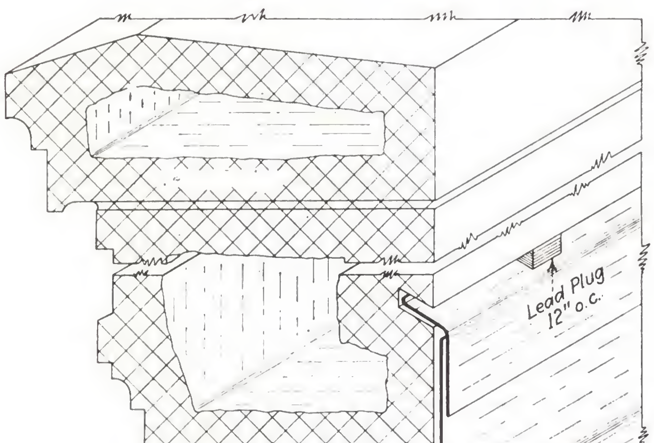


FIG. 7 BASE AND CAP FLASHINGS JOINING TERRA COTTA CORNICE ON PARAPET WALL

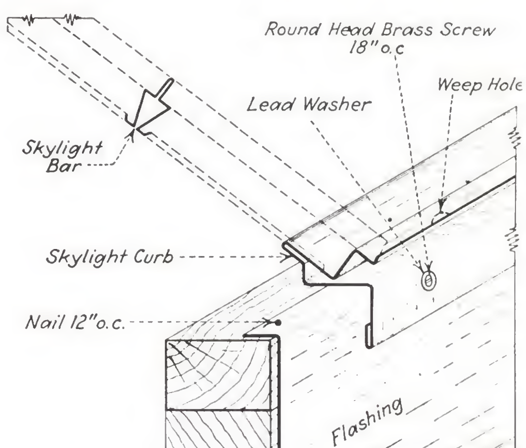
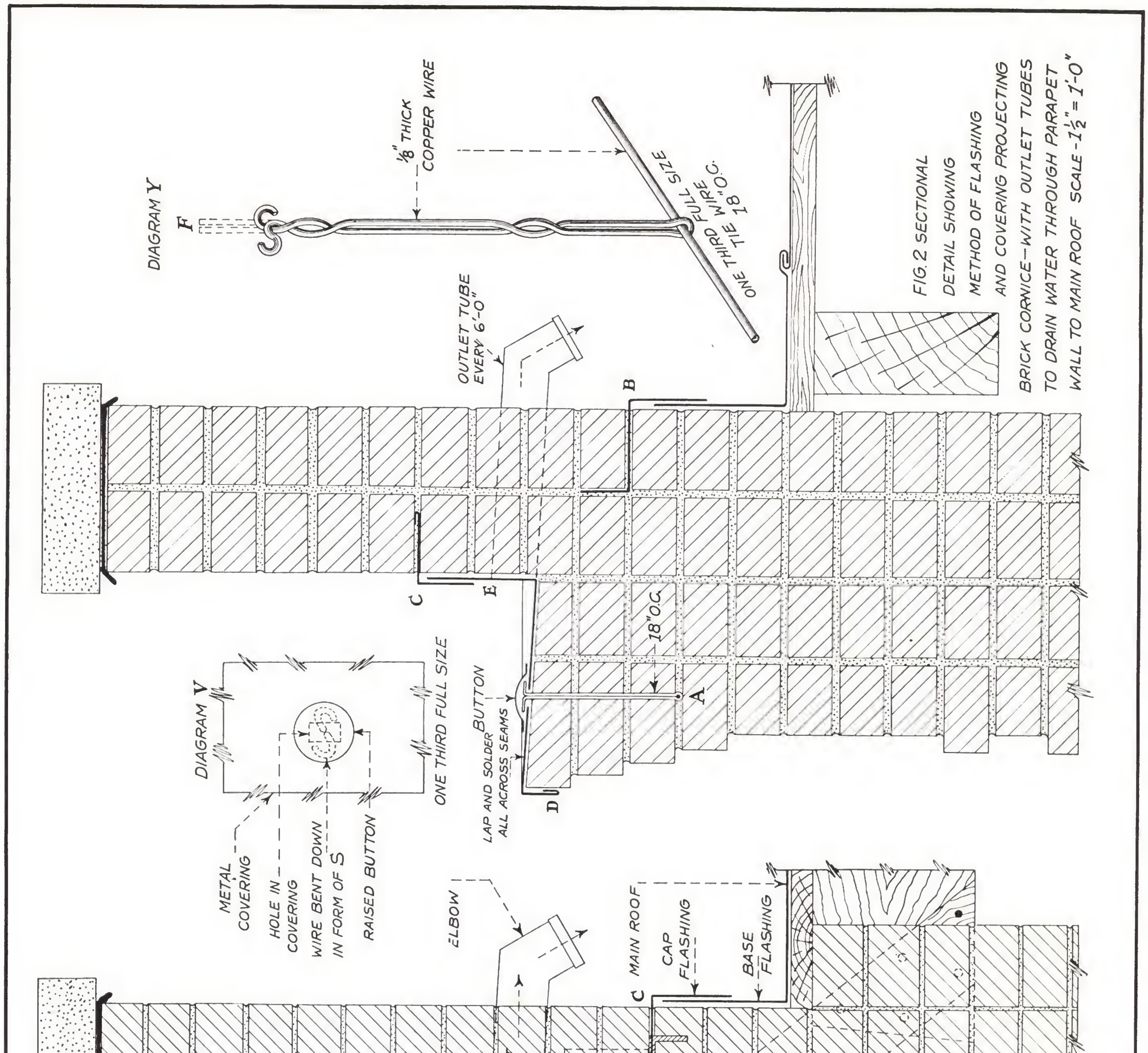


FIG. 8 BASE FLASHING JOINING WOOD CURB AND SECURING SHEET METAL SKYLIGHT

SCALE $1\frac{1}{2}$"=1'-0"

DRAWING NUMBER 52A — BASE AND CAP FLASHINGS TO WALLS OF VARIOUS CONSTRUCTION



DRAWING NUMBER 70

CORNICE COVERING AND OUTLET DRAINAGE TUBES

Cornice Covering and Outlet Drainage Tubes

Drawing No. 70

The method of flashing and covering the tops of sheet metal and brick cornices and utilizing outlet tubes to drain the water through the parapet walls to the main roof, is the subject of Drawing No. 70.

In Fig. 1 is shown a section of a sheet metal cornice. After the wall has been erected as high as *A*, the cornice is set and the wooden gutter bracket *B* nailed to each beam as indicated. When the masonry is as high as *C*, the cap flashing for the main roof is set, the wall continued as high as *D*, the cap flashing for the cornice placed and the masonry completed.

The roof is covered as shown, being locked to the front edge of the metal cornice as at *E*. The lock *E* may be turned down as shown at *F*, Diagram *X*. Openings about 6 ft. apart are left in the wall for outlet tubes, constructed as indicated. These tubes are passed through the wall from the inside, flanged and soldered to the base flashing.

Fig. 2 shows the procedure when the cornice is of brick. In this case the metal covering may be laid directly on the pitched brick roof, secured by means of copper tie wires as follows: Tie wires, bent as in Diagram *Y* with straight ends as at *F* and a cross wire at the bottom, are built in the wall about three courses of bricks below the roof line, 18 in. apart, as indicated at *A*. The last course of brick finishing the roof line is cut to give the desired pitch, as shown, the wall continued to *C*, the cap flashing set and the parapet wall completed with coping.

The top of the brick wall is covered as shown from *D* to *E* with wires passing through the covering and secured as shown in Diagrams *V* and *Y*. This method holds the covering in position and also provides for expansion and contraction of the sheet metal.

Cornice and Balustrade Flashing—Outlet Drainage Tubes

Drawing No. 71

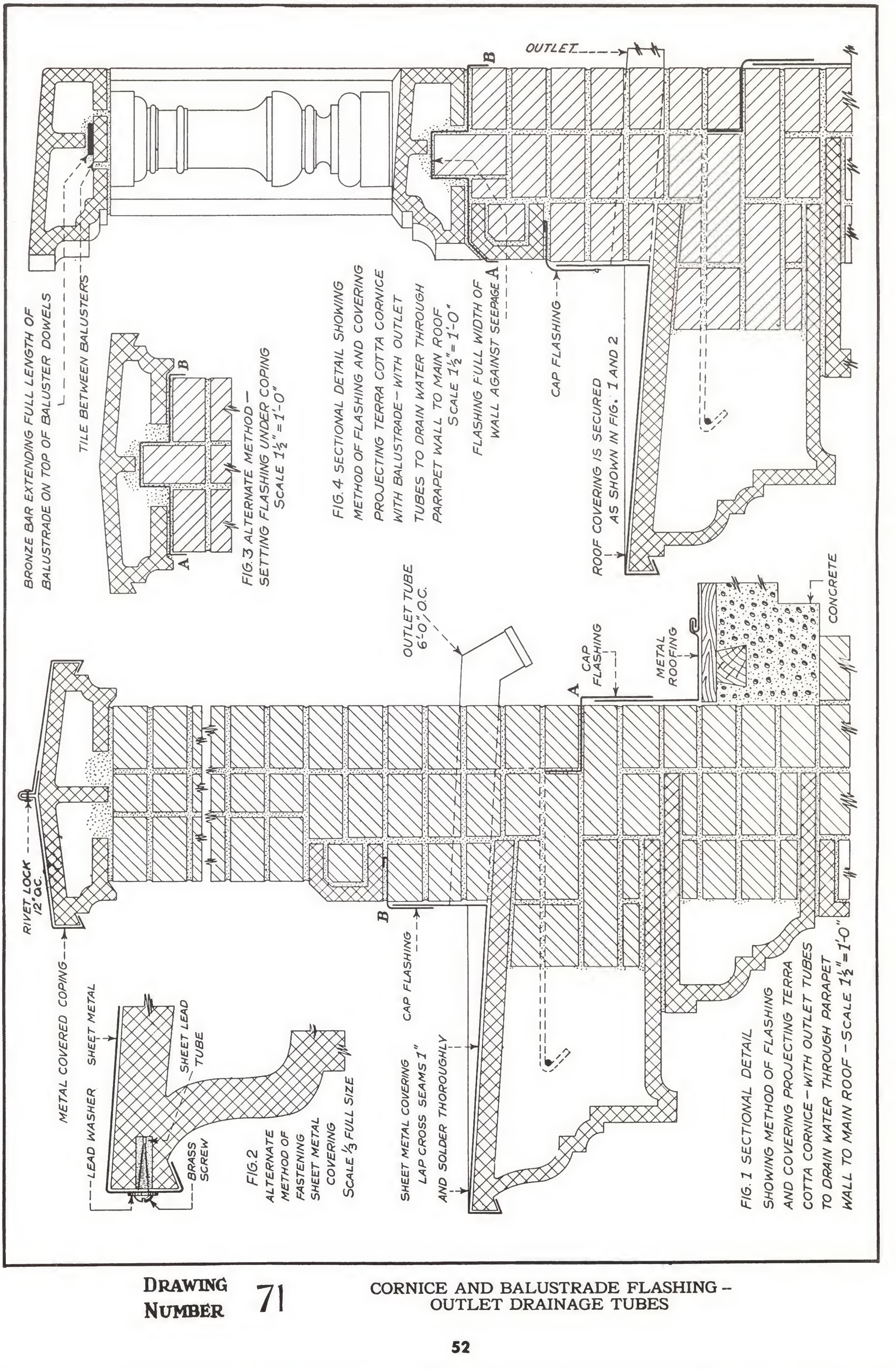
The method employed when terra cotta cornices and balustrades are flashed and the roof of the projecting cornice is drained by means of sheet metal tubes passing through the parapet wall to the main roof, is presented in Drawing No. 71.

In Fig. 1 is shown the main terra cotta cornice pitching toward the parapet wall. While the specifications are practically the same as for Drawing No. 70, here the cornice covering is hooked on the terra cotta drip and is prevented from slipping outward by the use of copper tie wire, inserted at every joint of the terra cotta cornice and secured as described in Diagram *Y*, Drawing No. 70.

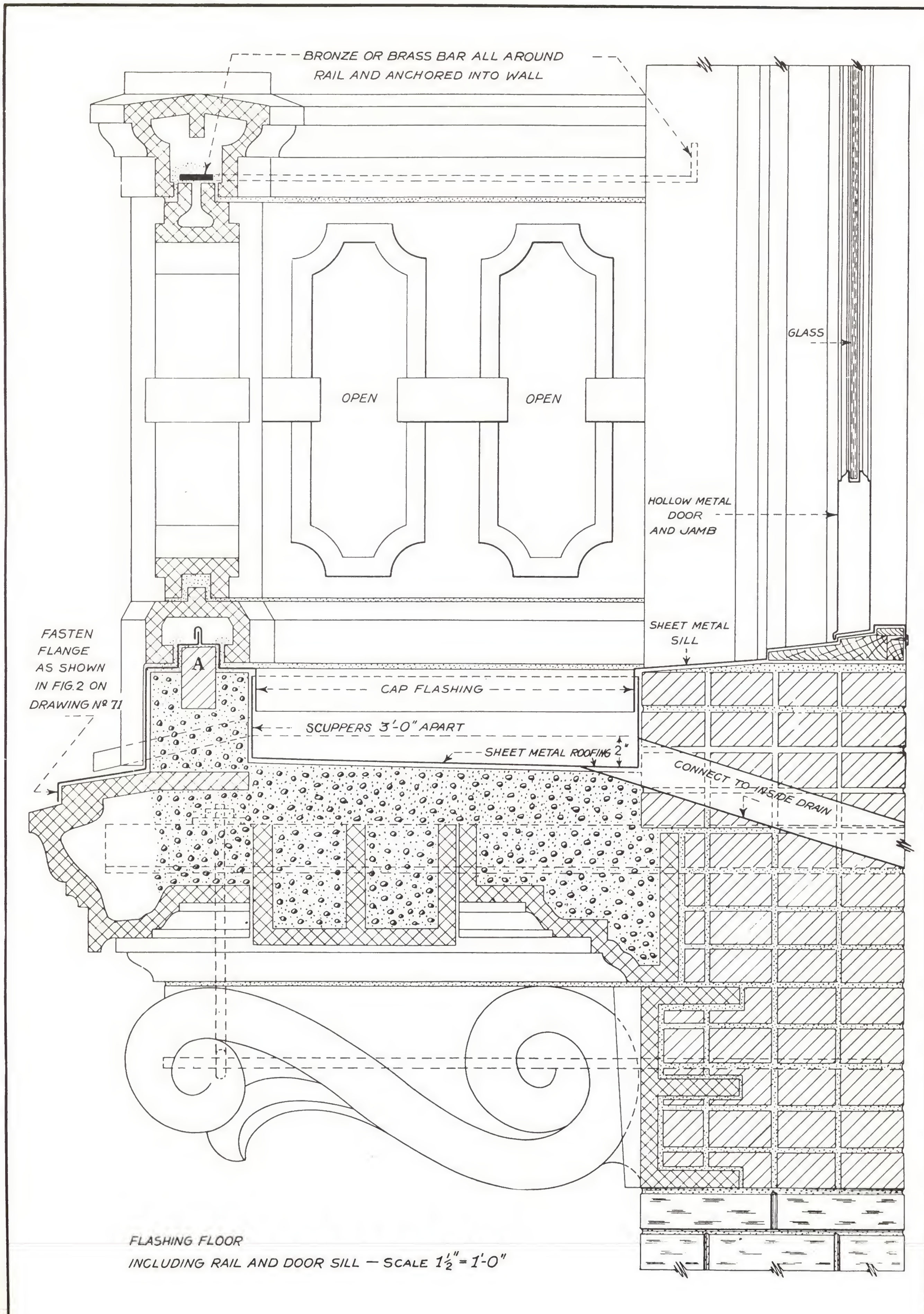
An alternate method of securing the sheet metal covering is shown, one-third full size, in Fig. 2. In this case ½ in. diameter holes, 1½ in. deep, 18 in. apart, are provided in the face of the upper member while the terra cotta is still in a plastic state. Before the covering is applied, lead expansion shields are inserted.

To prevent seepage through the parapet wall, the terra cotta coping is flashed as shown in Fig. 1, riveted every 12 in. through the standing lock. Seepage through the wall may also be prevented by the employment of the alternate method shown in Fig. 3. Here the center brick course is set edgewise and flashed with sheet metal as indicated from *A* to *B* in the drawing.

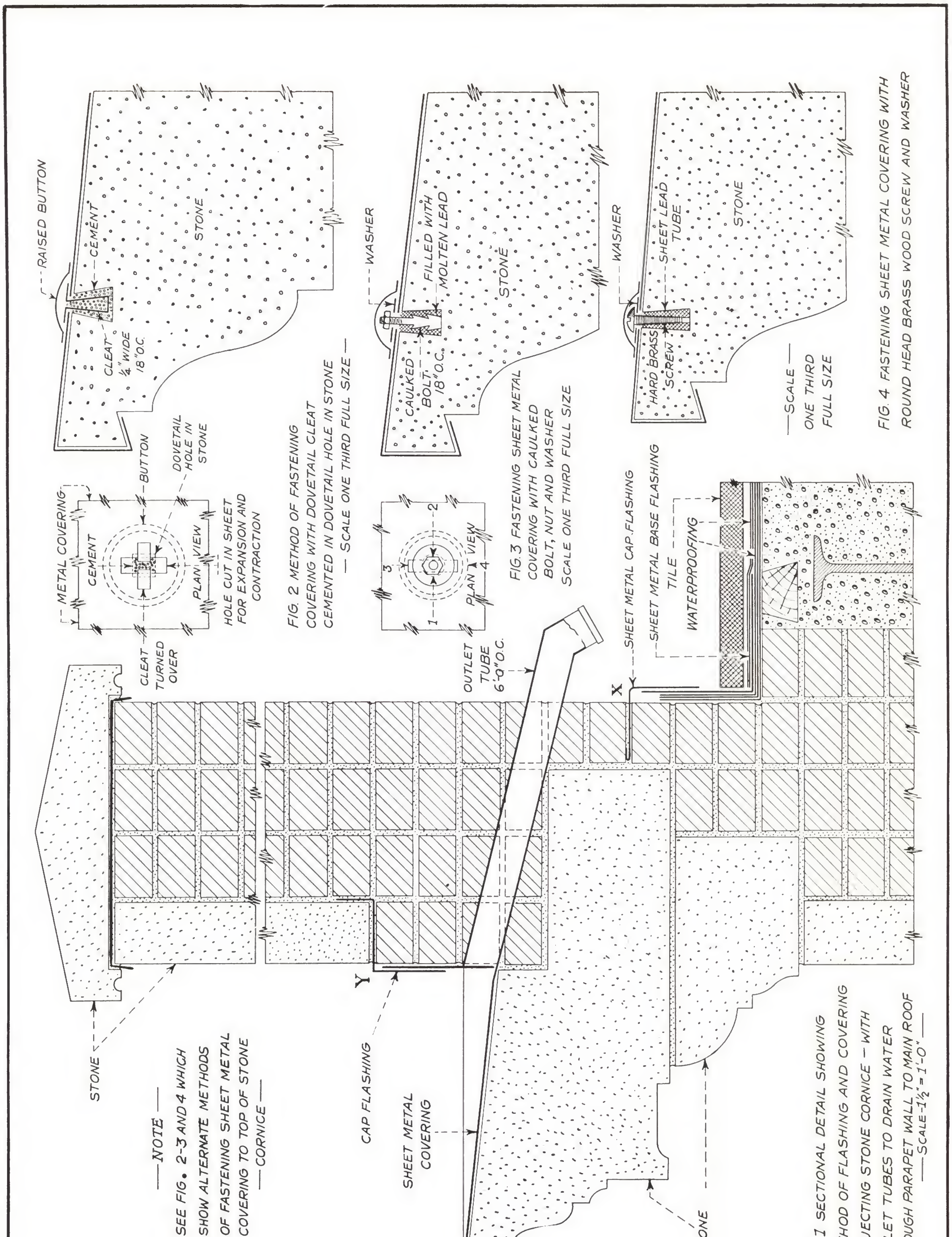
Fig. 4 is a sectional view of a terra cotta cornice with balustrade. After the wall has been carried up as high as *A-B* in Fig. 4, the center brick course is set edgewise and the full width of the wall covered. The balustrade is completed, a metal bar of either bronze or brass being used to secure the balusters.



DRAWING NUMBER 71 CORNICE AND BALUSTRADE FLASHING – OUTLET DRAINAGE TUBES



DRAWING NUMBER 72 BALCONY RAIL AND DOOR SILL FLASHING -- SCUPPER AND OUTLET TUBE



DRAWING NUMBER 73 STONE CORNICE FLASHING WITH OUTLET TUBE

Balcony Rail and Door Sill Flashing—Scupper and Outlet Tube

Drawing No. 72

In Drawing No. 72 are shown the methods used for flashing and covering the floor of a terra cotta balcony. In work of this kind it is important that the mason and the sheet metal worker receive the same details to avoid misunderstanding.

Note that in this case the floor of the balcony pitches toward the building and connects to inside drain pipe. The roof is covered with sheet metal laid flat seam, with $\frac{1}{2}$-in. locks, tinned on both sides, cleated every 8 in. and thoroughly sweated with solder.

The sill of the hollow metal door leading out to the balcony is flashed and covered, and also forms a cap flashing. The flashing under the terra cotta rail is bent and set as shown, and covers the front as well as the two ends and connects to the sill flashing. The rail flashing also acts as a cap flashing on the roof side and is flanged over the terra cotta on the outside, and is secured to the terra cotta as described in Fig. 2, Drawing No. 71.

Provision for taking care of the overflow in case the outlet tube to the inner drain becomes stopped up, is made by inserting scuppers about 36 in. apart, about 2 in. above the roof. The insertion of part of a brick on edge in the concrete, as shown at *A*, forms a key over which the flashing is set.

This method with minor modifications may be used for a stone balcony.

Stone Cornice Flashing with Outlet Tube

Drawing No. 73

Drawing No. 73 shows how a stone cornice is covered and the covering fastened to the stone work, three alternate methods being presented.

Fig. 1 shows the method of flashing the top of the cornice and the wall of the main roof. When the wall on the roof side is erected to *X*, the cap flashing is built in and when the parapet wall reaches the height of *Y* on the outside, the cap flashing is laid to turn up behind the stone facing. This construction is used in connection with a promenade tile roof.

The stone cornice has an angular drip in the top member to which the covering is attached, as shown at *A*. The rear end of the covering is slipped under the cap flashing and the water drained to the main roof by means of outlet tubes, placed 6 ft. apart. If one large outlet is used, it is placed in the center and the top of the cornice graded to this point. To prevent slipping of the metal covering, it must be secured to the stone work. Three alternate methods are shown in Fig. 2, 3 and 4.

Fig. 2 indicates how the covering is secured by means of $\frac{1}{4}$ in. wide dovetail cleats. Holes, perfectly square, are drilled in the stone work as shown, the width of the hole at the bottom equal to the width of the cleat at the bottom, for the easy insertion of cleat. The cleat projects about $\frac{3}{4}$ in. above the stone work and is secured in place with Portland cement. Holes are cut in the covering which is slipped over the cleat and the projecting flanges turned down, after the cement has hardened. Then raised buttons are soldered over the cleats. The hole or slot in the sheet is cut about $\frac{3}{4}$ in. long to permit free movement of the metal.

In the method shown in Fig. 3, a bolt is caulked into the stone work, then by means of washer and nut, the covering is secured. A plan view is given at the left of Fig. 3 in which 1 indicates the hole in the stone, 2 the bolt and nut, 3 the slot cut in the sheet and 4 the cap soldered over it.

A round head brass wood screw and washer are used in the method shown in Fig. 4. In this case, after the hole has been drilled into the stone, sheet lead tubes are inserted, and when wood screws are driven home, the lead expands against the side of the tapering hole and forms in effect an expansion bolt.

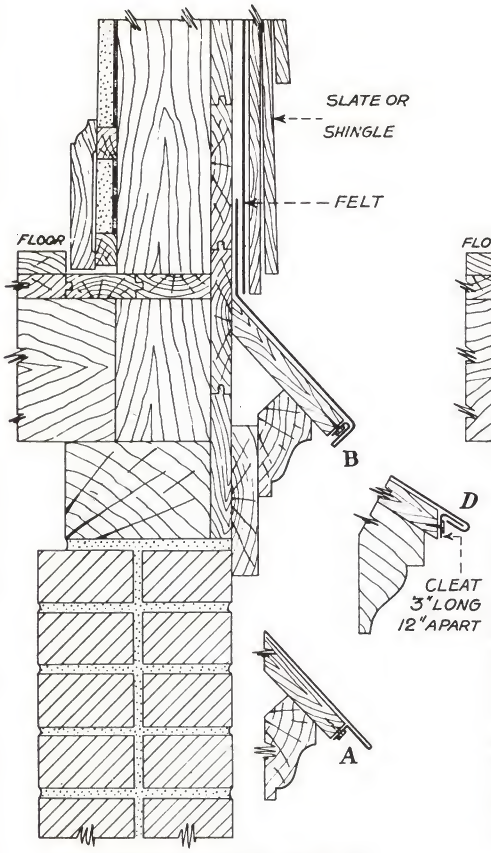
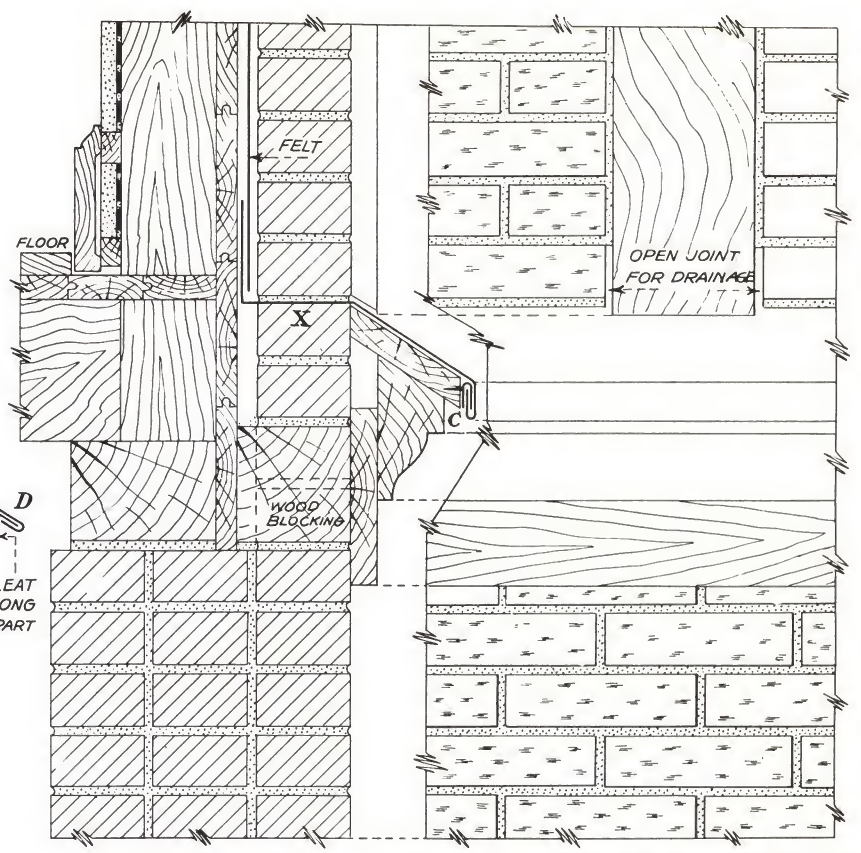
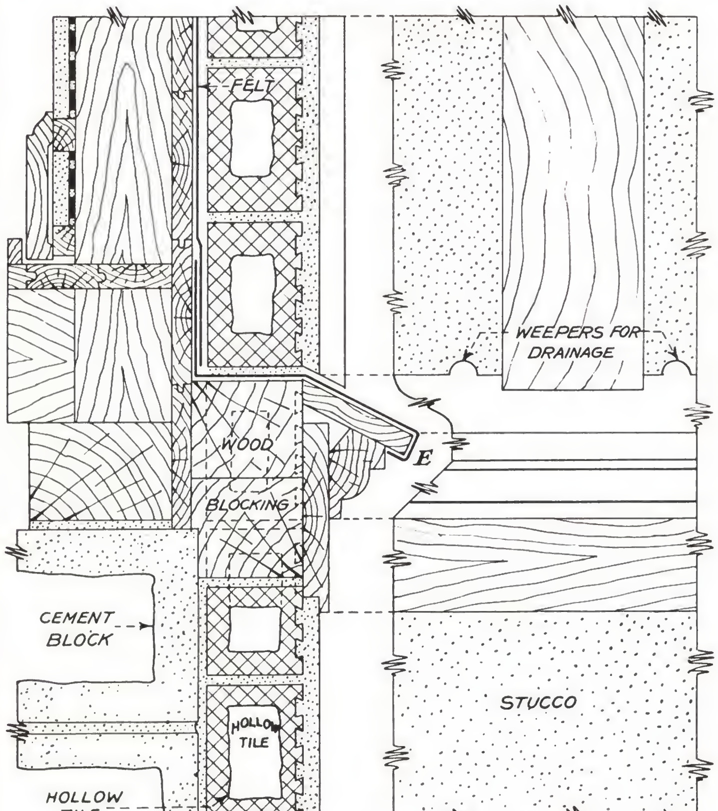


FIG 1 FLASHING WATER TABLE ON SLATE OR SHINGLE WALL — SCALE $1\frac{1}{2}" = 1'-0"$



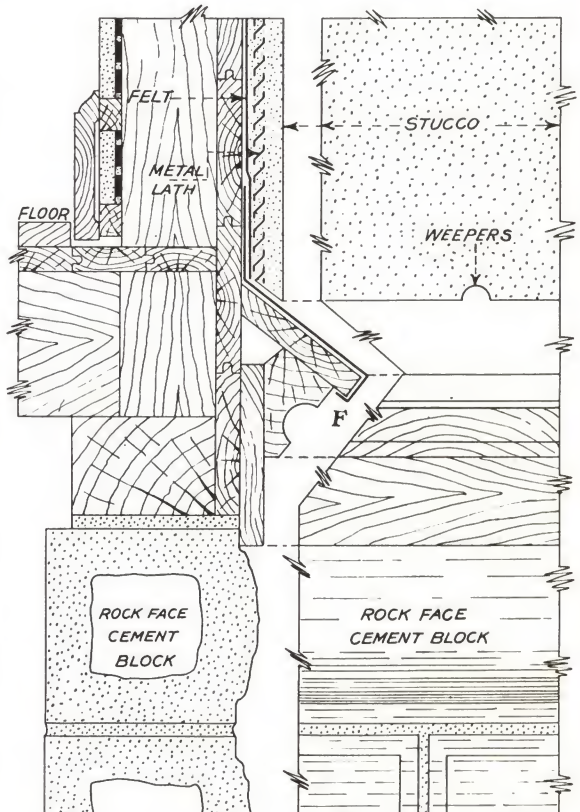
— SECTIONAL VIEW — PARTIAL ELEVATION SHOWING HALF-TIMBERED WORK

FIG. 2 FLASHING WATER TABLE ON BRICK VENEER WALL — SCALE $1\frac{1}{2}" = 1'-0"$



— SECTIONAL VIEW — — PARTIAL ELEVATION —

FIG. 3 FLASHING WATER TABLE ON HOLLOW TILE AND — — STUCCO WALL — SCALE $1\frac{1}{2} = 1'-0"$—



— SECTIONAL VIEW — PARTIAL ELEVATION

FIG. 4 FLASHING WATER TABLE ON METAL LATH AND STUCCO WALL — SCALE $1\frac{1}{2}" = 1'-0"$

DRAWING NUMBER 74

WATER TABLE FLASHING ON SLATE, BRICK VENEER AND STUCCO WALLS

Water Table Flashing on Slate, Brick Veneer and Stucco Walls

Drawing No. 74

The method of flashing a water table on four different wall constructions, is presented in Drawing No. 74.

Fig. 1 indicates the flashing when the wall is covered with either slate or shingles. The flashing is formed with a projecting double edge as shown at *A*, the edge *A* is malleted down, as shown at *B*, and the nail heads covered to prevent the nails from drawing out. The waterproofing felts on side walls under slate or shingles are then applied over the flashing as shown.

The water table flashed through brick veneer is presented in Fig. 2. Wood blocking is built in as the masonry progresses, and when the wall is as high as *X*, the wooden water table is completed so that the flashing is applied in one piece. The waterproof felt is laid over flashing and the wall continued. The finish at *C* is made by means of a cleat or eaves strip, more clearly shown at *D*.

When half-timbered work is used with brick veneer, the side joints of the lower course of brick, where it adjoins the woodwork, is left open to allow for drainage of any seepage, as indicated in the partial elevation presented in Fig. 2.

Fig. 3 shows the flashing of the water table when the wall is of hollow tile and stucco, and the specification is identical with brick veneer, with the option of the flashing hooking over the upper member of the wash, as at *E*.

Brads are placed through the bottom of the lower edge about 3 ft. apart to hold the flashing in position until the masonry is continued. All cross seams are well soldered. Weepers for draining the seepage are placed in the stucco at the flashing line every 2 or 3 ft. as shown in the partial elevation.

In Fig. 4 is shown how the water table is flashed when the construction of the wall is of metal lath and stucco. The flashing is hooked over the lower edge of the wash as shown at *F* and secured with a few brads until the cross seams are soldered. Over the vertical flashing, the felt is placed and over the felt the wire lath is secured and the stucco completed. Weep holes are placed as shown in the partial elevation about 3 ft. apart.

Window Frame Flashings on Shingle or Brick Veneer Walls

Drawing No. 75

In Drawing No. 75 are presented the methods of flashing the window sill, jamb and head on slate, shingle and brick veneer wall constructions.

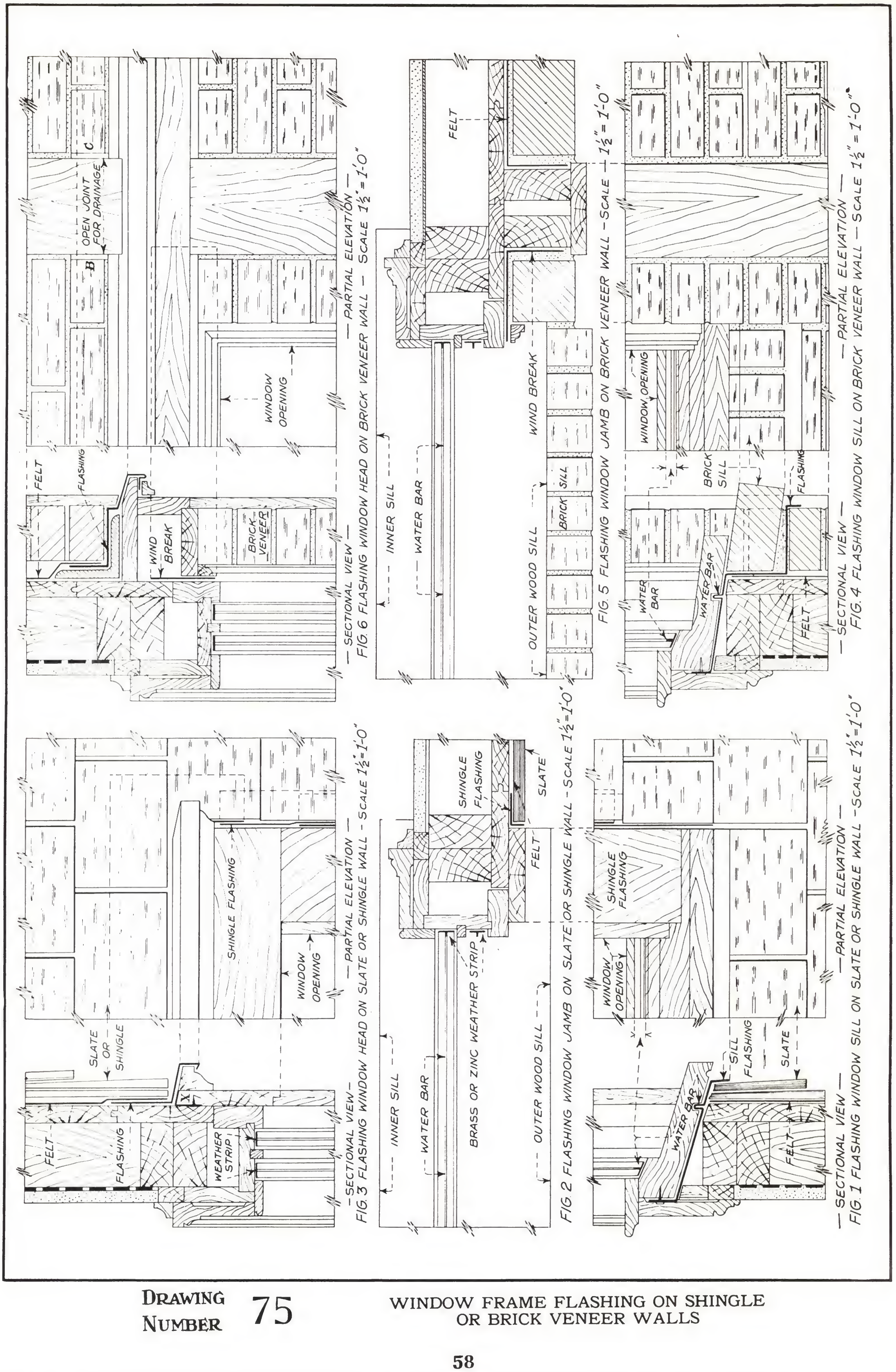
The flashing of the window sill when the wall is of either slate or shingle is described in Fig. 1. Note that felt is first laid over the sheathing and, after the slate or shingles are applied, the window frame is set, the metal flashing being secured to the under side of the sill with a water bar, as shown. Single flashings are also laid in with the courses of slate or shingles against the projecting side of the jamb as shown in the partial elevation and more clearly presented in Fig. 2, which represents a section through the jamb.

Fig. 3 shows the method of flashing the window head on a slate or shingle wall. Note that the projecting head is flashed so that it hugs the first member of the wood mold as shown and forms a drip. This is not nailed, and assuming that the caps are flashed before the window frames are set, then two or three cleats are soldered under the flashing and drawn and nailed as shown at *X*. Care is taken to insure that the felt, applied over the sheathing, laps the metal flashing the full height as shown.

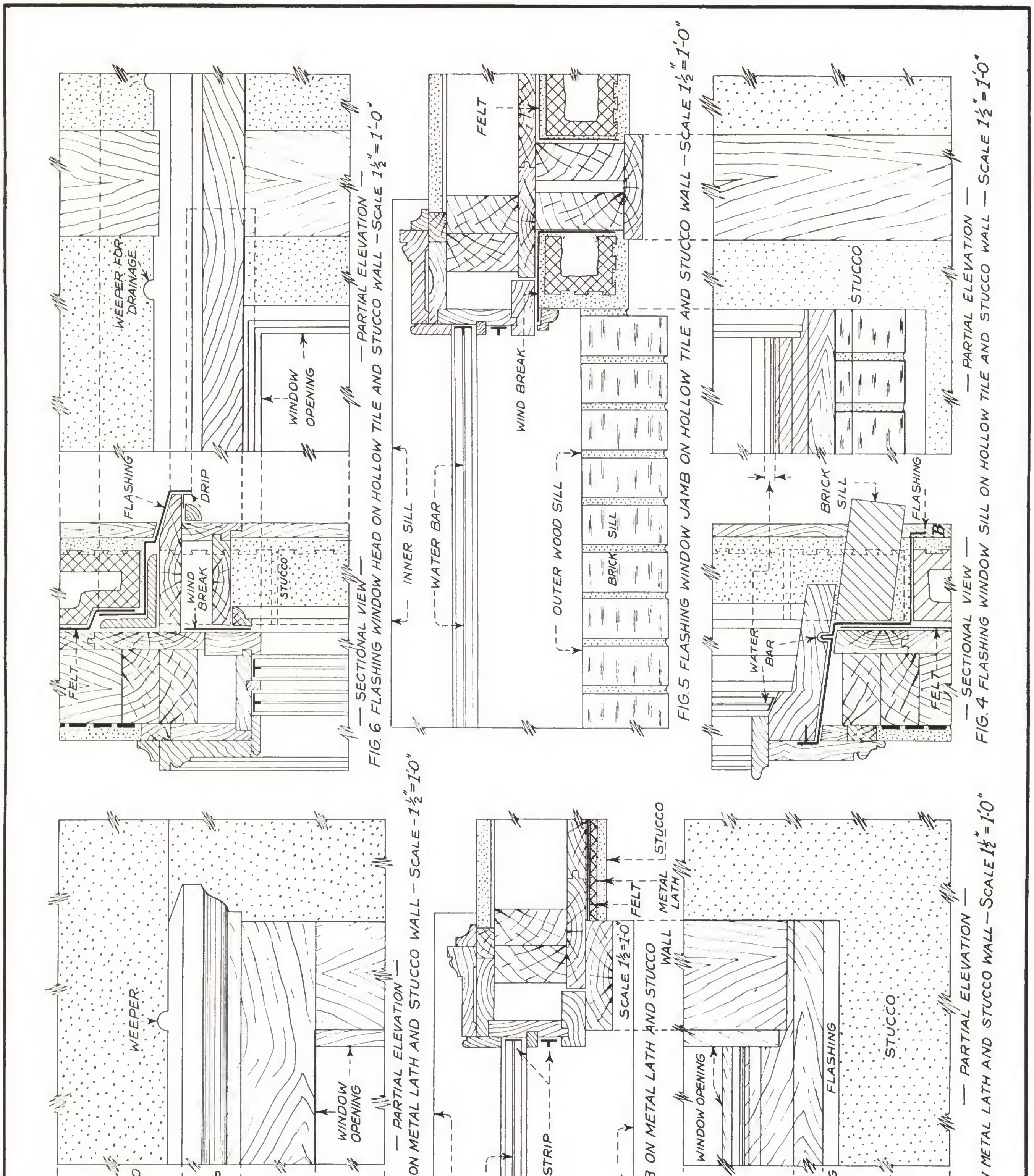
The method of putting in the sill flashing when the wall is of brick veneer, is indicated in Fig. 4. In this construction brick veneer and half-timbered work is used. The flange is nailed to the back of the sill and allowed to overlap the brick wall at least $3/4$ in.

In Fig. 5 is given a section through the jamb showing the method of putting in a sheet metal wind break or angle the full height of the window frame. Note the layer of felt which is always laid over the sheathing before the brick veneer work is started.

The window head flashing on a brick veneer wall is shown in Fig. 6. After the window frame is set and before the projecting window head is built, a flashing strip or wind break is nailed in position the full width of the window frame. When the window head is built, the angle iron lintel is painted with asphaltum, then set as shown, and flashed. Upon this flashing the felt overlaps and the masonry is continued. Where the brick veneer intersects the horizontal member of the half-timbered work, as shown at *B* and *C* in the partial elevation, the joints at the sides of the lower course of brick are left open for drainage.



DRAWING NUMBER 75 WINDOW FRAME FLASHING ON SHINGLE OR BRICK VENEER WALLS



DRAWING NUMBER 76 WINDOW FRAME FLASHING ON METAL LATH, STUCCO WALLS

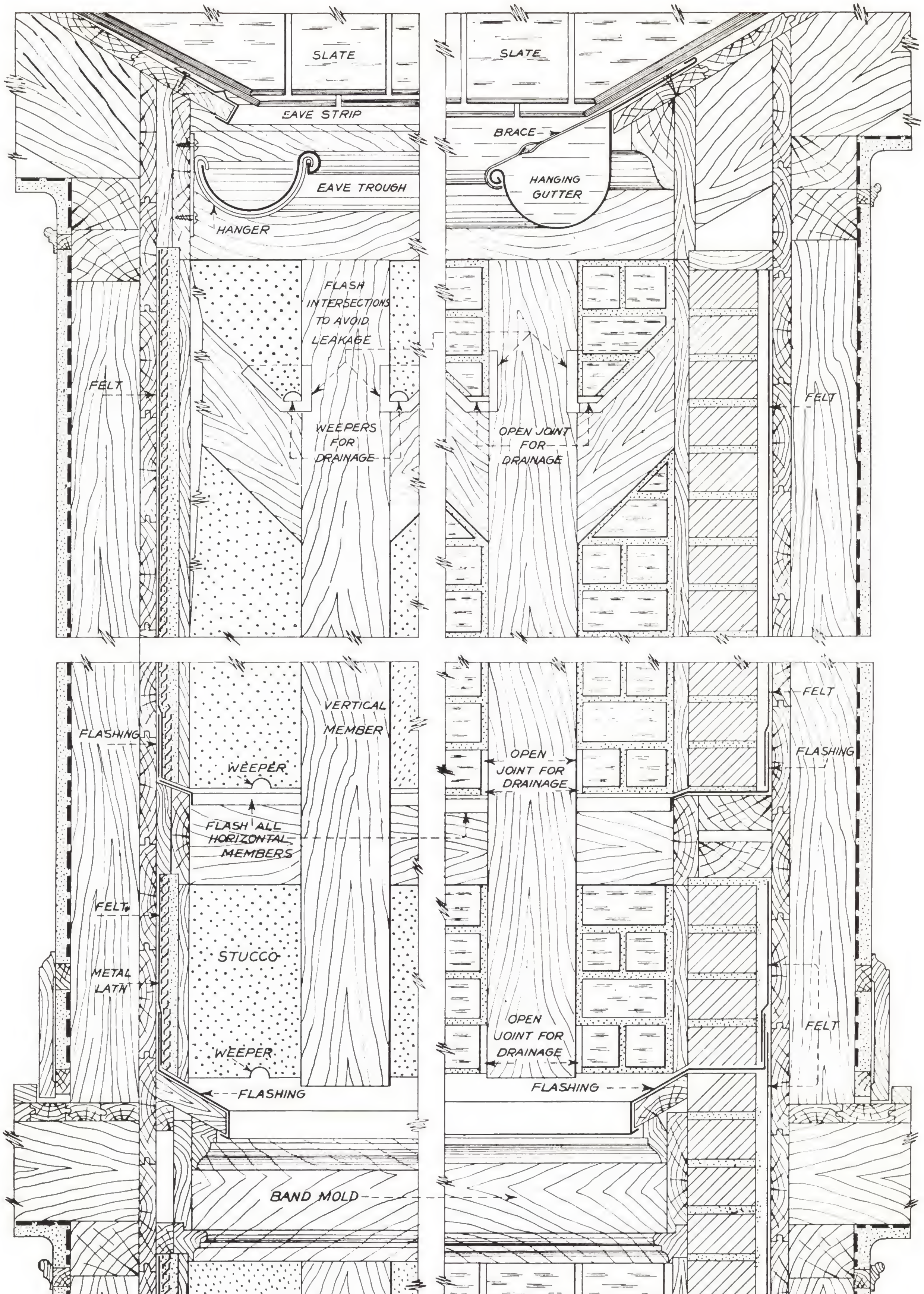


FIG. 1 METHOD OF FLASHING ON STUCCO WALL — SCALE $1\frac{1}{2}'' = 1'-0''$ — FIG. 2 METHOD OF FLASHING ON BRICK VENEER WALL

DRAWING NUMBER 77

BAND MOLD AND TIMBERED WALL FLASHING

Window Frame Flashing on Metal Lath, Stucco Walls

Drawing No. 76

The method of applying flashings to window sill, jamb and head when the walls are of stucco on either metal lath or hollow tile, is presented in Drawing No. 76.

Fig. 1 shows the flashing applied to the sill when metal lath and stucco are used for the wall. Note the water bar which sets into the groove cut in the bottom of the wood sill, the flashing being carried up behind the sill and nailed as shown.

A section through the jamb and window frame is shown in Fig. 2.

In Fig. 3 is presented a section through the window head on metal lath and stucco wall. The flashing over the window head is nailed along the front edge if desired, allowing it to extend below the upper member to form a drip. A better method of fastening is to solder two or three cleats to the under side of the flashing as at *A* and then nail to the frame at the back. Of course, this must be done before the window frame is set. It is good practice to have the weepers in the stucco over the window head flashing to allow any moisture to drain out.

Fig. 4 shows a sectional view and partial elevation of a flashed window sill on a hollow tile and stucco wall. In this case, before the brick sill is laid, the flashing is set over the last course of hollow tile, which projects the thickness of the stucco as at *B*, forming a water bar, and flanging and nailing to the back of the wood sill as shown. After the flashing is in place, the brick sill is completed.

A section through the jamb on a metal lath and stucco wall is given in Fig. 5. Note the metal wind break or angle placed the full height of the window frame.

In Fig. 6 is shown the flashing and metal wind break for a window head when the wall is of hollow tile and stucco. In this construction, the angle iron lintel is first set, then the window head flashed with metal, care being taken to cover the flashing with a heavy coat of asphaltum where it comes in contact with the angle iron. Over this flashing the felt is placed. The drip shown is held in place by a quarter round wood mold. Weepers for drainage are placed at intervals as indicated in the front elevation.

Band Mold and Timbered Wall Flashing

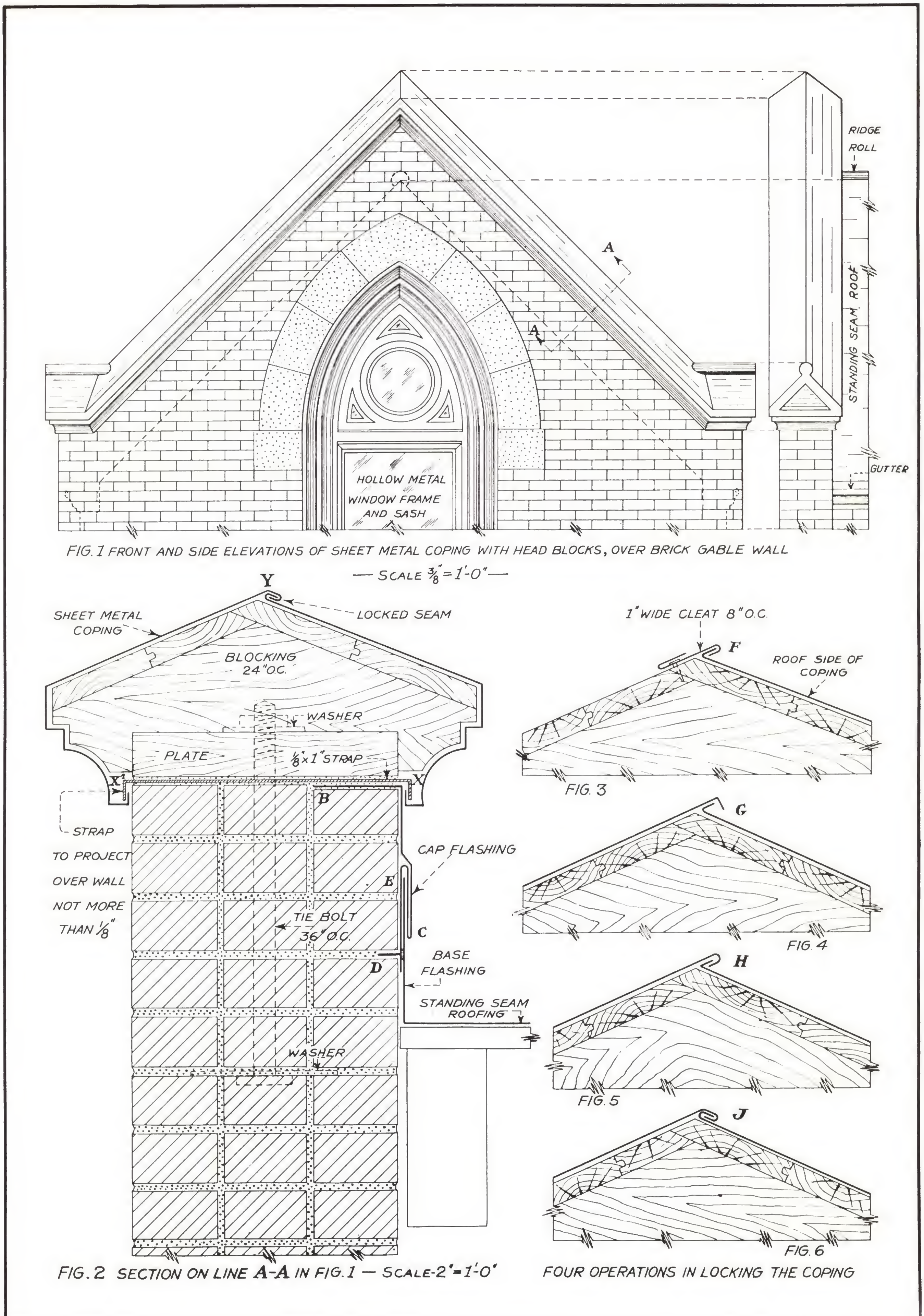
Drawing No. 77

Drawing No. 77 shows the method of flashing required in connection with half-timbered work on either stucco or brick veneer walls.

In Fig. 1 is shown the procedure when the wall is constructed of metal lath and stucco. The top of the band mold as well as all tops of horizontal and intersecting members of half-timbered work are flashed, as shown. The wood members usually shrink away from the stucco and brick work and leave small openings through which rain can enter. The flashing extends up under the felt not less than 2 in. Where the half-timbering intersects and forms pockets, these are flashed as shown. Weepers for drainage are provided as indicated.

Where an eaves trough is used, the eaves are covered with an eaves strip as shown, the cant strip being bent on same in the form of an inverted *V* as indicated.

Fig. 2 shows similar flashing, but on a wall constructed of frame and brick veneer, weepers are provided.



DRAWING NUMBER 78 COPING OVER BRICK GABLE WALL

Coping over Brick Gable Wall

Drawing No. 78

Drawing No. 78 shows the construction of a sheet metal coping with head blocks on a brick gable wall. Leakage is prevented by means of the drip at the bottom.

In Fig. 1 is presented a front and side elevation of a gable coping with head blocks. A detailed method of construction on line *A-A* in Fig. 1 is shown in Fig. 2. When the wall has been finished to a point as indicated by *B*, a sheet metal cap flashing is applied. This is formed as shown by *B-C-D-E* and is laid on the wall in a continuous length, parallel with the pitch of the roof. The flange projects below the double fold or pocket at *C* and is nailed at intervals to the brick joints as shown at *D*.

To make a storm-proof connection the base flashing is slipped into the pocket as indicated at *C-E*. Straps made of $1/8$ x 1 in. bar metal, with ends turned down at right angles are laid on the wall, 18 in. on centers, before wood plate is secured in place with the bolts built in the wall as shown. On this plate wood blocks of the required size and shape are nailed and sheathed as shown.

The roof side of the metal coping is first hooked under the strap as at *X* and the upper lock turned up slightly more than a right angle, as shown at *F* in Fig. 3. The opposite half of the coping is then hooked under the strap as at *X′* in Fig. 2, with the upper lock turned down as at *G* in Fig. 4 and turned under as indicated at *H*, Fig. 5, and finished as shown at *J*. Fig. 6. The lock when in the position shown at *H* in Fig. 5 is painted with thick white lead and then malleted down. All cross seams are riveted and well soldered.

Molded Coping and Wall Covering

Drawing No. 80

Fig. 1 to 5, inclusive, in Drawing No. 80 show the construction of molded sheet metal coping applied on a wood base. Fig. 1 indicates the coping connected to a vertical sheet metal wall covering, in case it is required that the entire wall on the roof side be covered with sheet metal. If the wall extends over 18 in. above the roof line, it is advisable to apply the cover with standing seams, securing the vertical seams in the joints of the brick work by means of wall nails and cleats spaced 8 in. apart. This standing seam covering acts as a cap flashing over the base flashing, as shown in Fig. 1.

At the sheathing line an edge is turned outward and secured with cleats as shown at *A* in Fig. 2. The roof of the coping is locked to the side as shown at *B* in Fig. 1.

There are two methods by which the molded face may be secured to the roof of the coping. One method is shown at *C* in Fig. 3 and is finished as indicated at *E* in Fig. 1. The other is shown in Fig. 4 where a double edge forms a support on the sheathing to which it is nailed. The roof covering is locked to the projecting edge *D* and turned down. Fig. 5 shows a coping where the wall is not over 18 in. above the roof line and the base flashing or roof sheets are turned up and slipped into a pocket formed on the inside edge of the cover sheet, which is held in place by nailing to the wood plate at *F*.

Sheet Metal Copings on Horizontal Walls

Drawing No. 81

Three types of sheet metal coping on horizontal walls secured to wood plates by different methods, are presented in Drawing No. 81.

Fig. 1 shows a type secured to the underside of the wood plate by brass screws and brass washers. The angles at *A* and *A* are bent slightly more than called for in the profile so that when the coping is pressed over the wood plate it snaps in place and the flanges at *B* and *B* hug the wall.

In Fig. 2 is presented a simplified alternate method in which case the edge of the sheet metal is folded back on itself then turned outward at an angle of about 30 deg. which stiffens the lower edge and forms a drip edge.

Fig. 3 shows another type of coping secured to the wood plate by blind nailing. A continuous strip of metal, folded back on itself with the double edge turned outward at an angle of 30 deg., is nailed in place to which the coping is locked.

When the coping is being formed, the flange is bent as at *H* in the upper diagram, then the edges turned under as shown at *F* which gives rigidity and forms a drip edge.

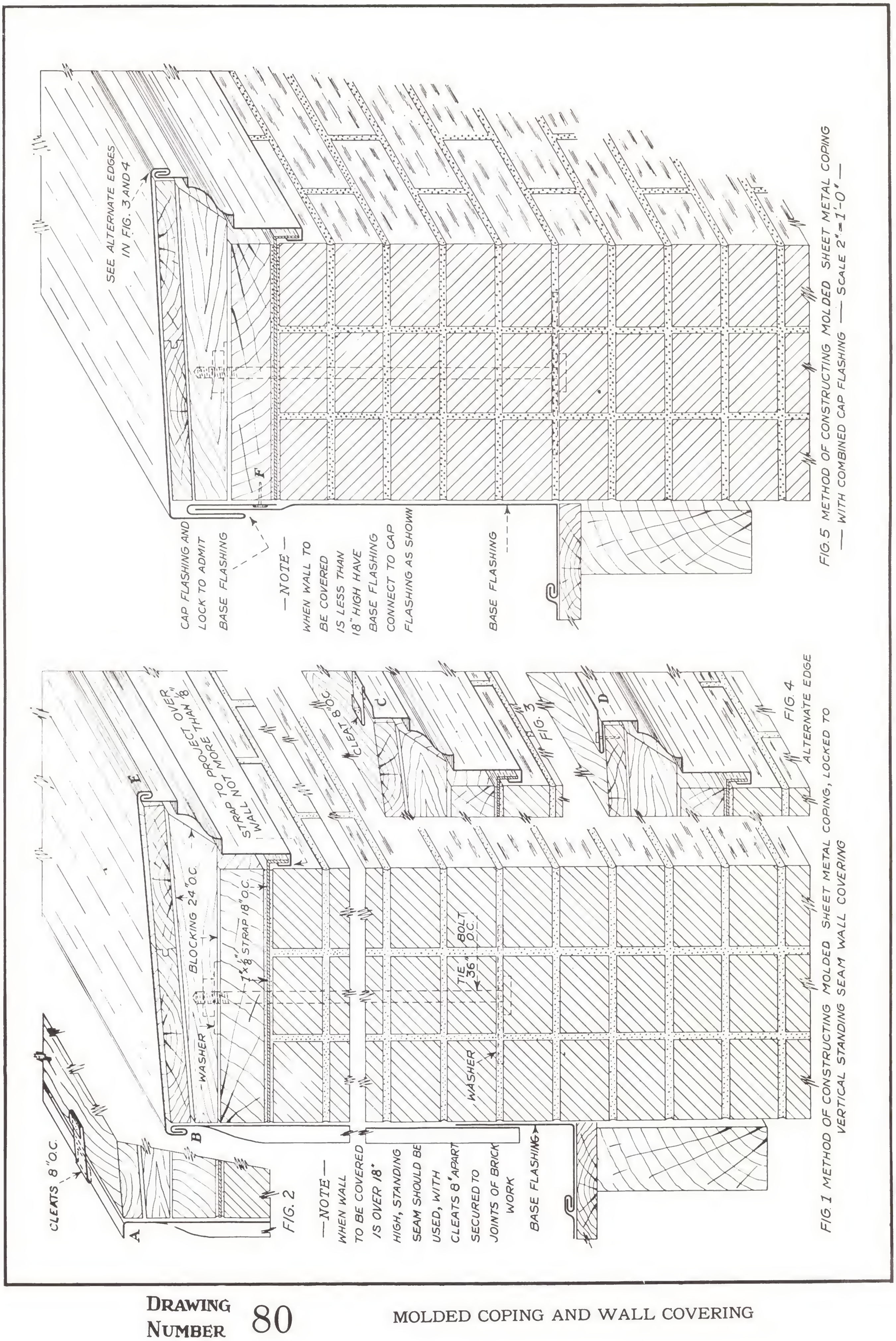


FIG. 1 METHOD OF CONSTRUCTING MOLDED SHEET METAL COPING, LOCKED TO VERTICAL STANDING SEAM WALL COVERING

FIG. 5 METHOD OF CONSTRUCTING MOLDED SHEET METAL COPING — WITH COMBINED CAP FLASHING — SCALE 2"=1'-0" —

Drawing Number 80 MOLDED COPING AND WALL COVERING

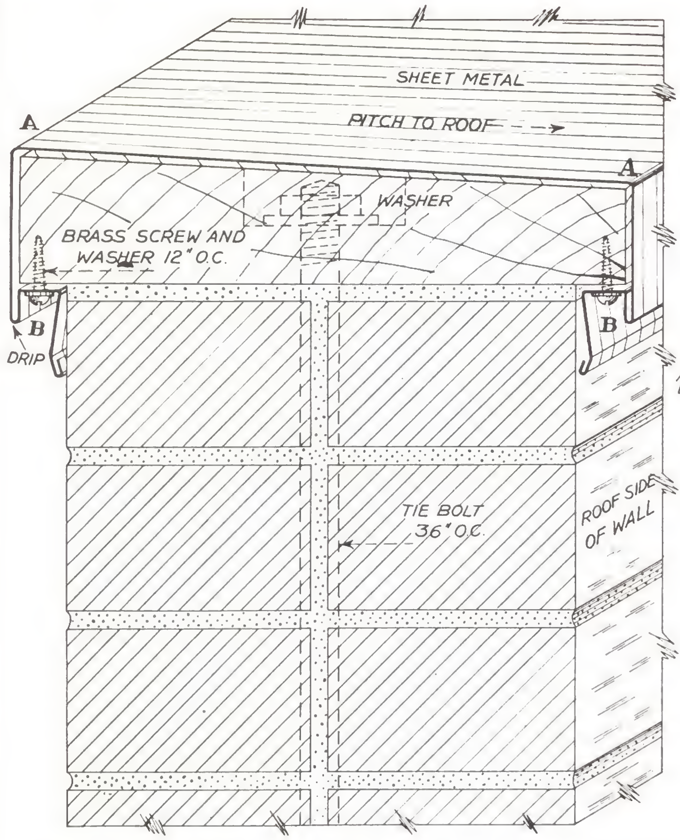


FIG. 1 SHEET METAL COPING — SECURED WITH BRASS SCREWS
— SCALE – ONE THIRD FULL SIZE —

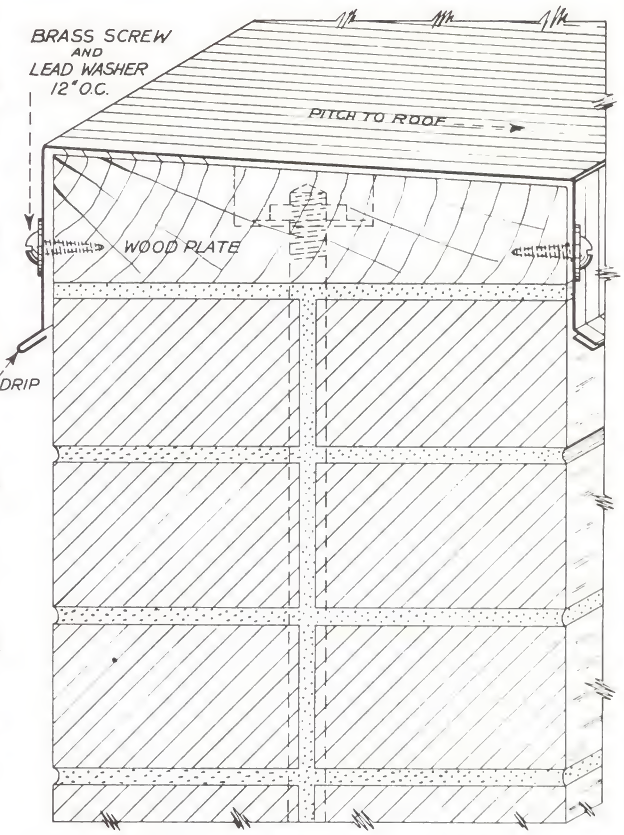


FIG. 2 SHEET METAL COPING — ALTERNATE METHOD
— SCALE – ONE THIRD FULL SIZE —

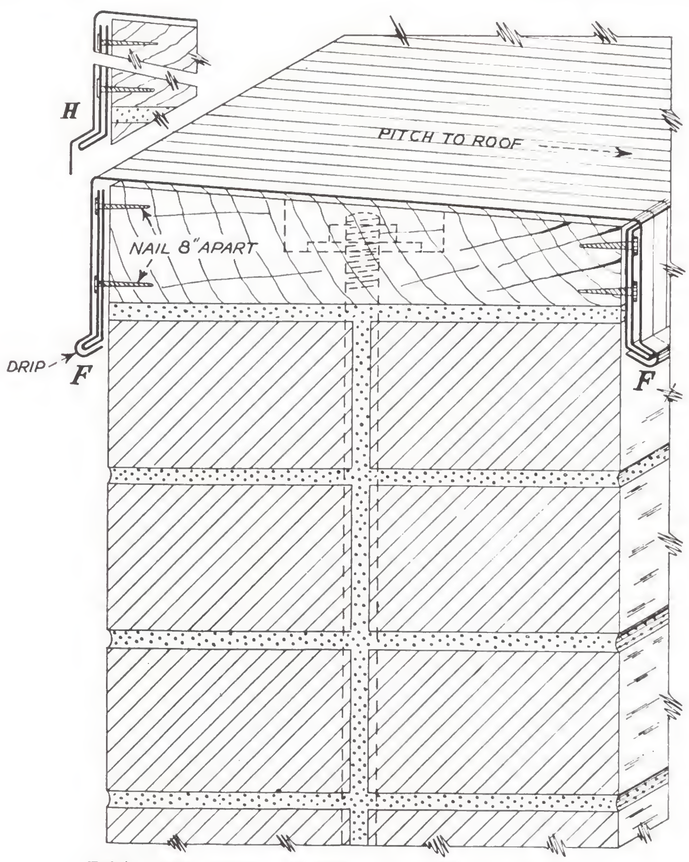
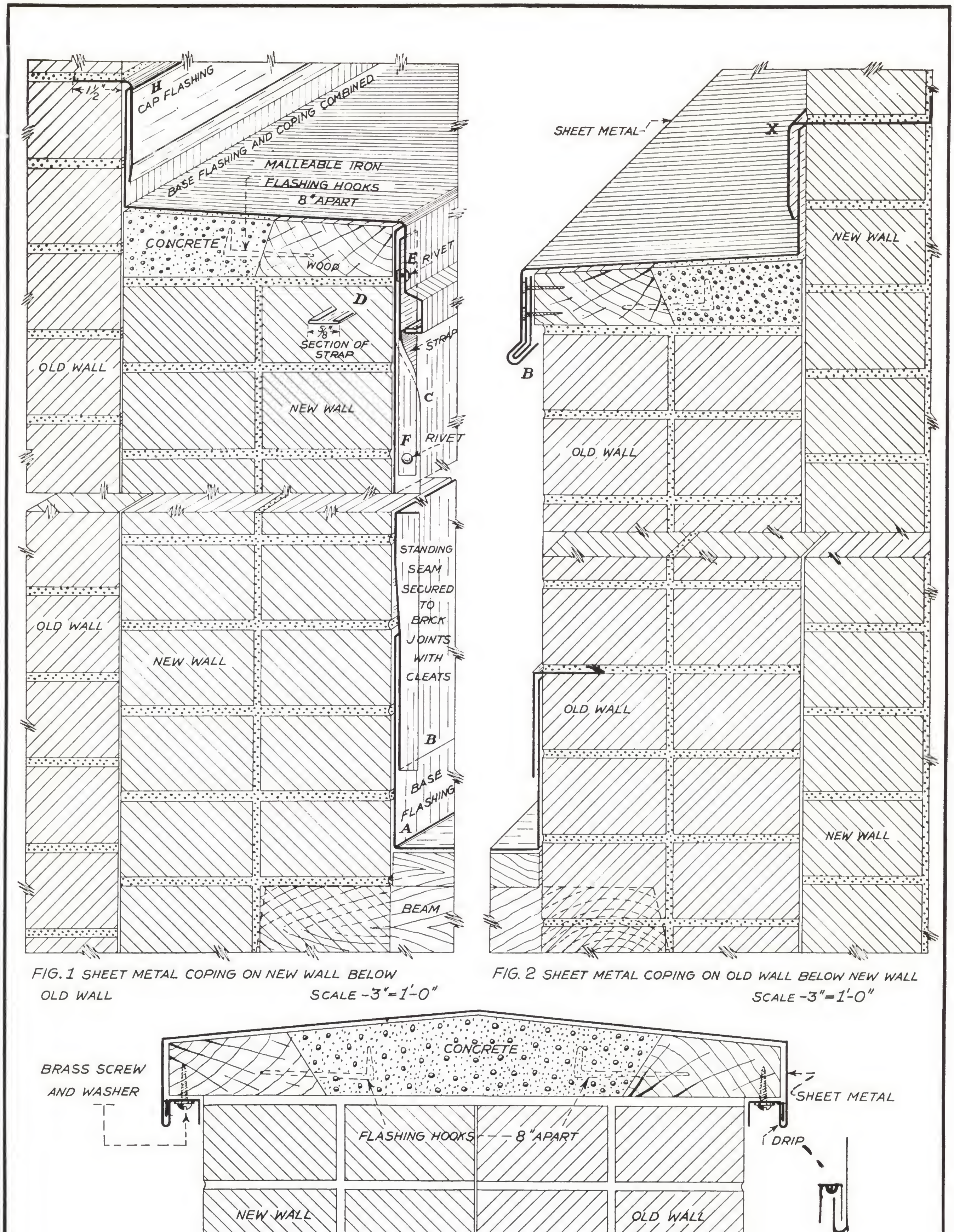


FIG. 3 SHEET METAL COPING — ALTERNATE METHOD
— SCALE – ONE THIRD FULL SIZE —

DRAWING NUMBER 81

SHEET METAL COPINGS ON HORIZONTAL WALLS



— FIG. 3 SHEET METAL COPING OVER OLD AND NEW WALLS — SCALE 3"=1'-0" —

Drawing Number 82

COPING AT ADJOINING OLD AND NEW WALLS

Coping at Adjoining Old and New Walls

Drawing No. 82

Drawing No. 82 indicates three types of coping set over old and new walls when the walls adjoin. Fig. 1 shows the construction when the new wall is stopped at a point below the old wall. The base flashing *A* is first laid. The standing seam siding overlaps the base flashing as at *B*. The wood plate is set in place with flashing hooks driven in the edge about 8 in. apart as shown, after which the concrete is poured so that the pitch of the coping is toward the roof. At the upper end of the wall covering the standing seam is flattened as shown at *C*.

Before applying the siding, cleats similar to *D* are riveted to the coping at *E*, spaced so as to permit riveting to the standing seam as shown at *F*. The mortar joint in the old wall, about 4 in. above the coping, is dug out 1½ in. and cap flashing *H* inserted and secured in place with wall nails or lead plugs, and the joint pointed up with elastic cement.

Fig. 2 shows the construction when the new wall is carried above the old wall. In this case, the cap flashing *X* is built in as the masonry progresses and a coping of the form shown is secured to the continuous double folded strip as indicated at *B*.

In Fig. 3 is shown the construction when the coping is to cover old and new walls built to a common level and needs no further description.

Corrugated Roofing and Siding on Wood Structure

Drawings No. -1A-1B

The methods of applying corrugated iron roofing and siding on wood structure are presented in Drawings No. 1A, 1B

Drawing No. 1A shows a detailed section through the eaves on the line *D-D* in Fig. 2, Drawing No. 1. Note the form of the eaves mold, with a pocket at the lower part to receive the corrugated siding. When securing the conductor, hinged conductor fasteners are employed as shown, fastened to the siding with two galvanized round head wood screws to each side flange.

In Drawing No. 1B, Fig. 8, presents the detail through the window head. Note the covering of the head with a drip at the bottom and a water table at *A* to shed the water.

Fig. 9 is a section through the window sill. In this case the entire sill is covered as shown with a combination drip and pocket at *B* in which the siding is placed. A section through the window jamb is given in Fig. 10. Note how the jamb is formed with a waterlock at *C*. In Fig. 11 a section through the siding at the base of the building is shown. A concrete base is employed and is flashed as indicated along the baseboard. A drip is provided at the bottom and a flashing runs up behind the corrugated siding. The conductor is secured at the base with a galvanized hinged conductor fastener.

A section through the corner casing is shown in Fig. 12, with pockets to receive the corrugated siding.

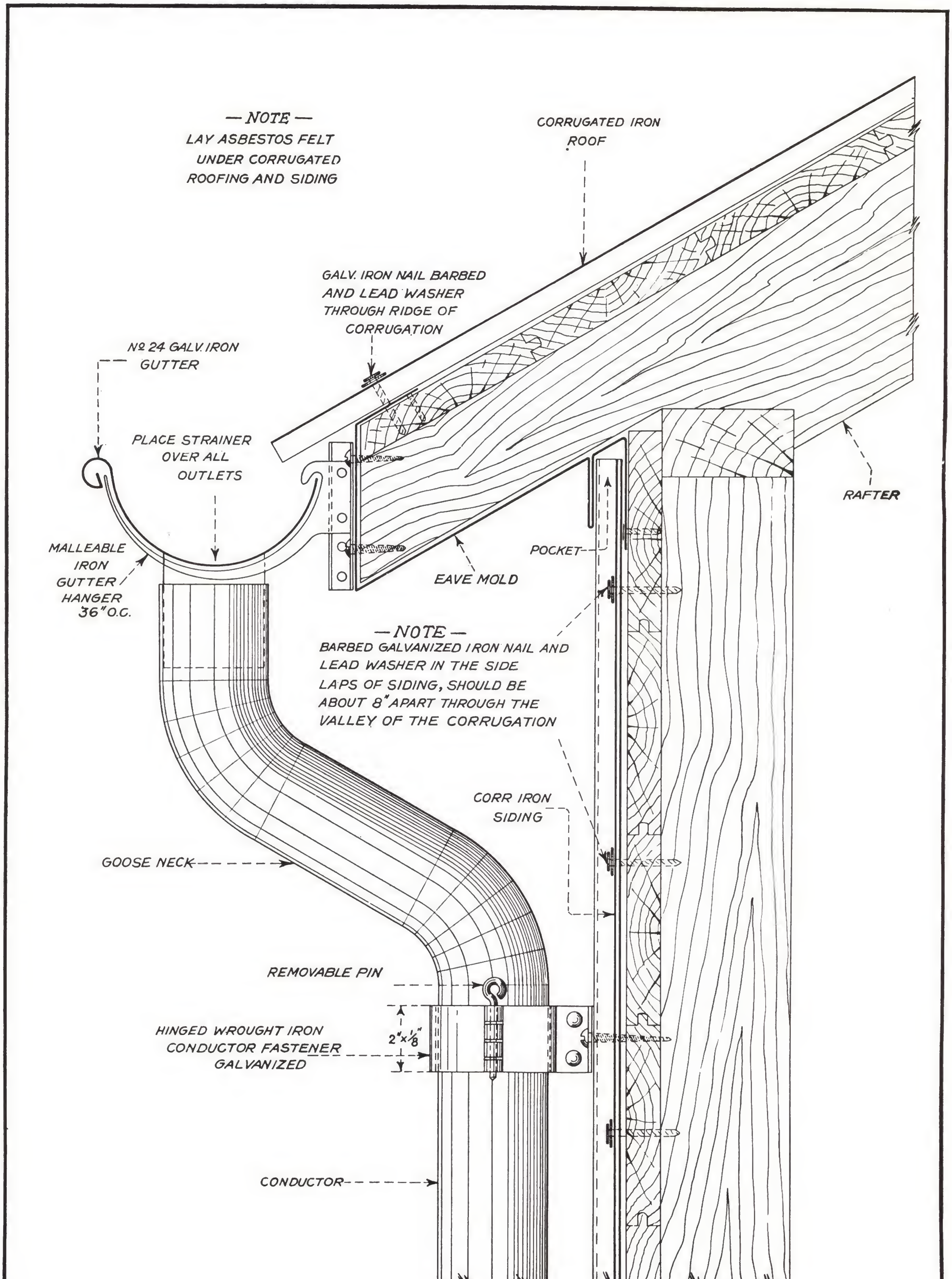


FIG. 7 SECTION ON LINE **D-D** IN FIG. 2 ON DRAWING Nº 1
— SCALE 3" = 1'-0" —

DRAWING NUMBER 1A

CORRUGATED ROOFING AND SIDING ON WOOD STRUCTURE

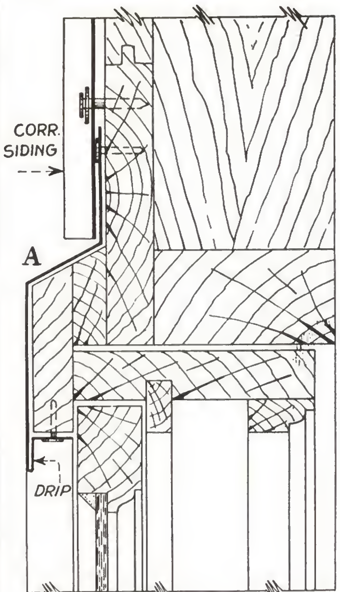


FIG. 8 SECTION ON LINE **E-E** IN FIG. 2 ON DRAWING Nº 1

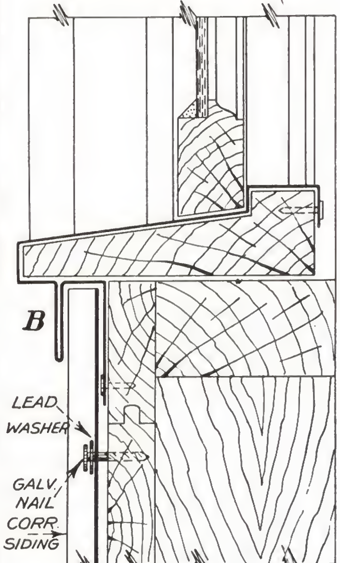


FIG. 9 SECTION ON LINE **F-F** IN FIG. 2 ON DRAWING Nº 1

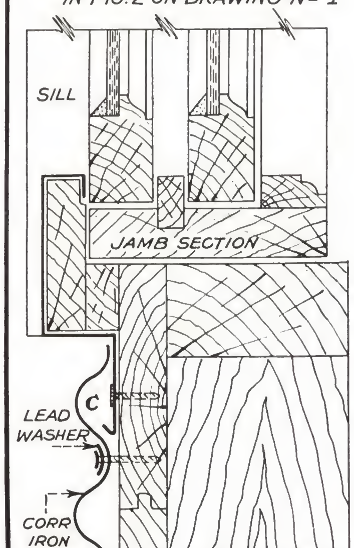


FIG. 10 SECTION ON LINE **J-J** IN FIG. 2 ON DRAWING Nº 1

—NOTE—
LAY ASBESTOS FELT UNDER CORRUGATED ROOF AND SIDING

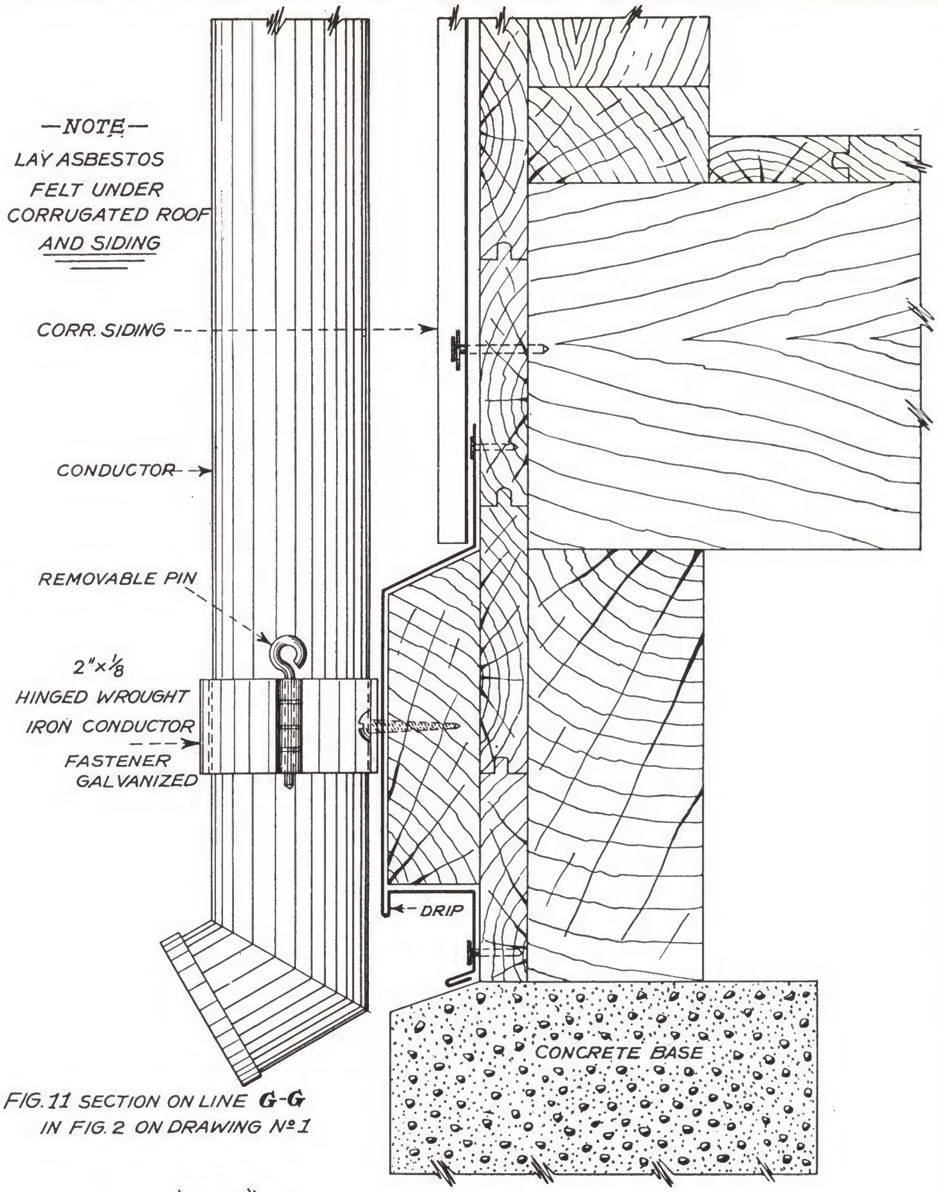


FIG. 11 SECTION ON LINE **G-G** IN FIG. 2 ON DRAWING Nº 1

—NOTE—
—ALL DETAILS ARE ONE FOURTH—
—FULL SIZE OR 3"=1'-0"—

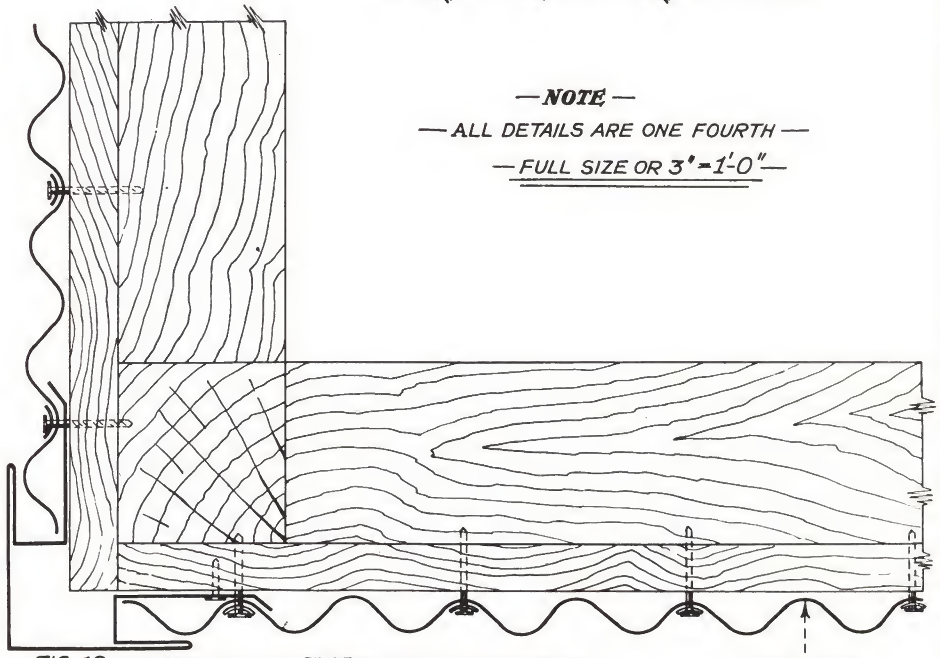


FIG. 12 SECTION ON LINE **H-H** IN FIG. 2 DRAWING Nº 1

DRAWING NUMBER 1B

CORRUGATED ROOFING AND SIDING ON WOOD STRUCTURE

Special Details

The detail drawing below and the three drawings which follow show cap and base flashing practices submitted by sheet metal contractors. Also the construction for a scuttle and curb.

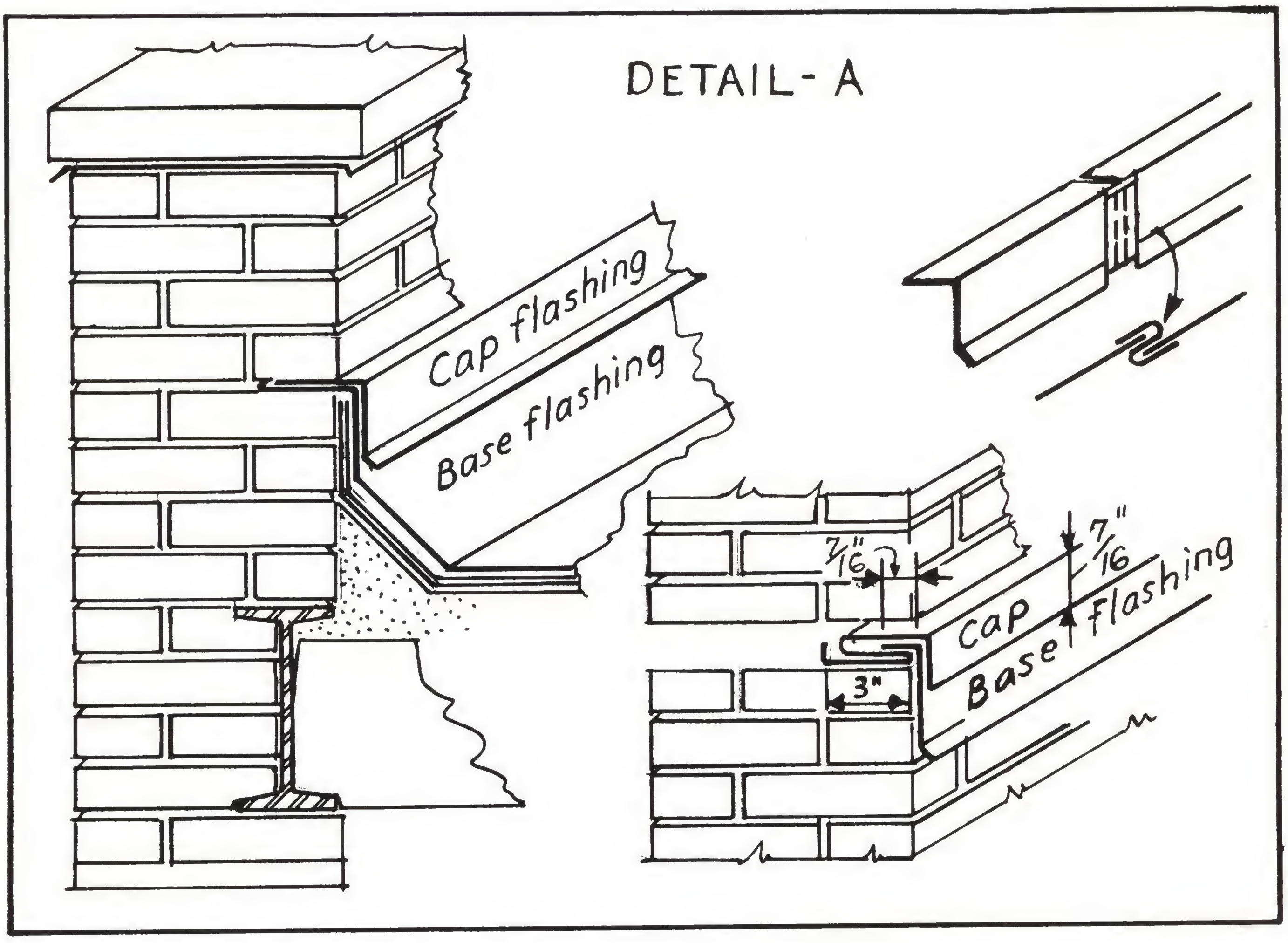
Detail A illustrates a cap flashing exposing a single thickness of metal which can be opened up should it become necessary to re-roof or install new base flashing.

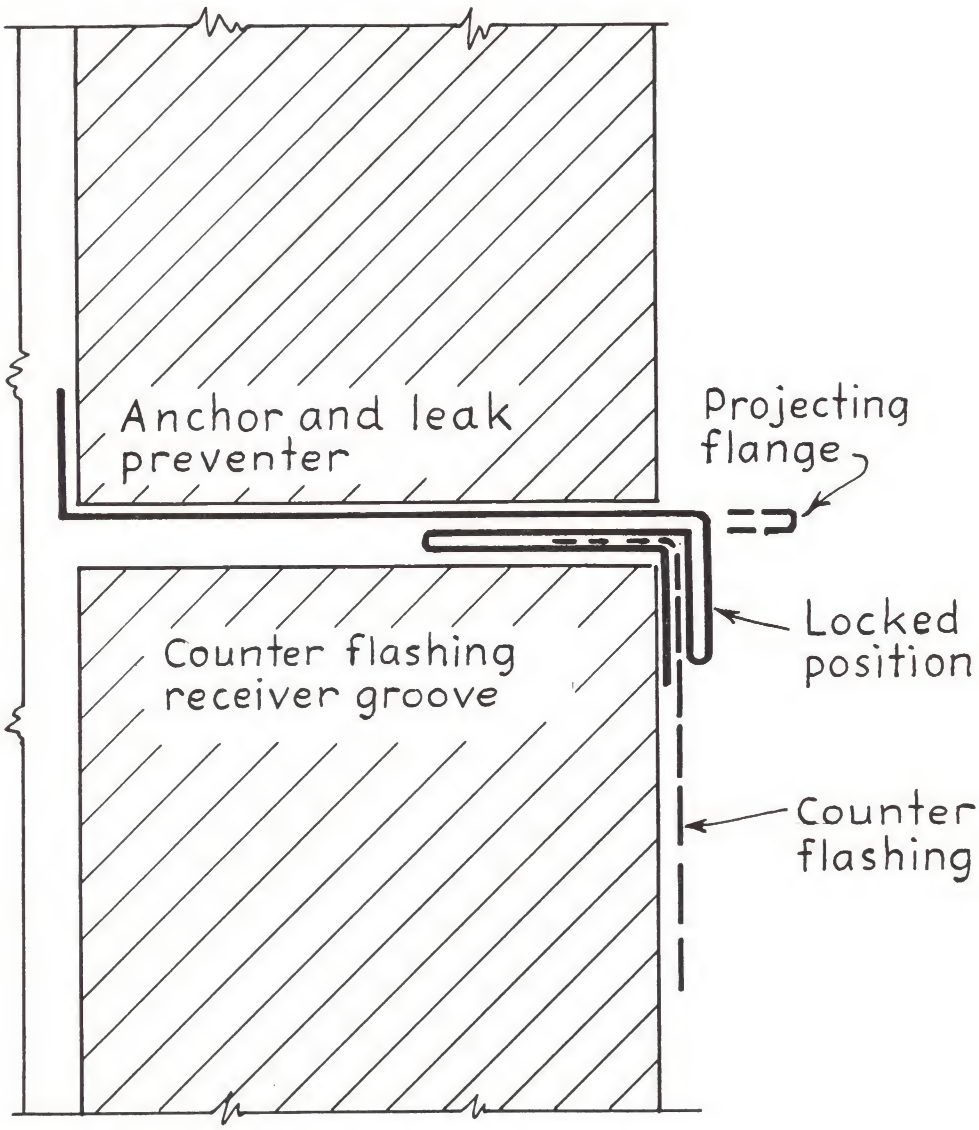
This counter flashing is joined by S-slips on the vertical face—no locks on the horizontal face.

The Detail submitted by the Olson Corp. shows another construction which allows opening up for re-roofing. In the Olson construction the exposed vertical face is doubled—a stiffer construction.

The Detail submitted by the Pauley Company has only a single thickness of metal embedded in the mortar joint. The doubled exterior face is stiff, but can be opened up for re-roofing. In the Pauley construction, the end joints are covered with the "Joint Cover" shown in a sketch.

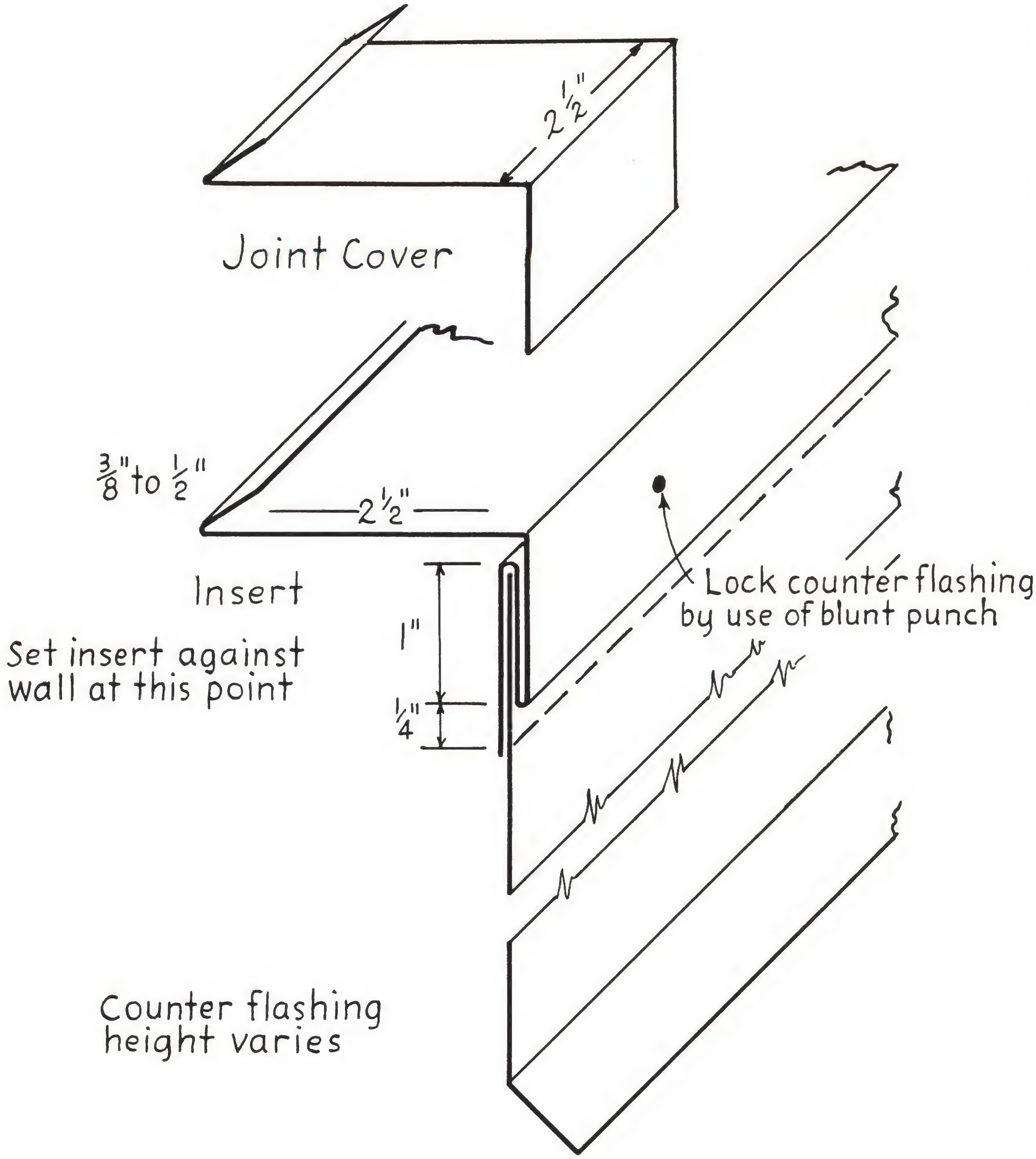
The Detail showing metal construction for a scuttle and curb provides complete metal covering for the curb top surfaces—which cover becomes the cap flashing as shown.



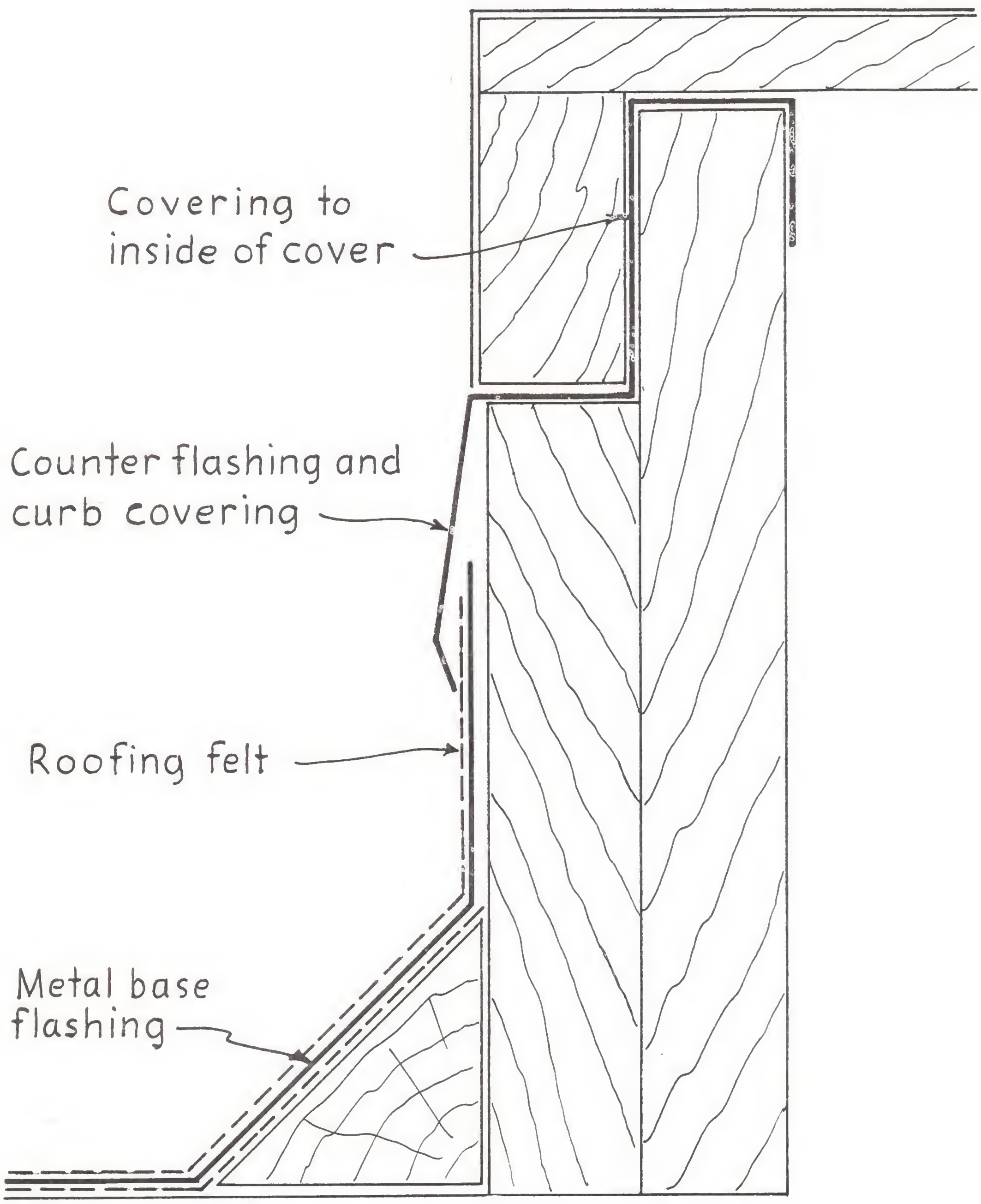


Flashing Receiver

Submitted by Olson Corp.



Submitted by Ray E. Pauley Company, Inc.



Detail of Scuttle & Curb

Reference

Sheet Copper
Copper and Brass Research Association

Zinc Workers Manual
American Zinc Institute

Guide For Sheet Metal Workers
Carnegie-Illinois Corporation

Roofing Specifications
Follansbee Steel Corporation

Copper and Common Sense
Revere Copper and Brass Incorporated

Anaconda Through-Wall Flashings
American Brass Co.

Through-Wall Flashings
Chase Brass and Copper Co., Inc.

Flashings By Cheney
Cheney Flashing Co.

Wasco Copper Fabric Flashing
Wasco Flashing Co.

Sandell Through-Wall Flashing
Sandell Roofing Co.

Coping and Gravel Stops
Aluminum Company of America

Roofing, Siding and Gutters
Reynolds Metal Co.

Slate Roofing
Vermont Slate Co.
O'Brien Brothers Slate Co.
Rising and Nelson Slate Co.
Shelden Slate Co.
Ludodici-Celadon Co.
Ludowici-Celadon Co.

Lead
National Lead Company

SKYLIGHTS–VENTILATORS

SHEET METAL CONTRACTORS NATIONAL ASSOCIATION, INC.

170 DIVISION STREET • ELGIN, ILLINOIS

A National Organization to Improve, Extend and Protect the Uses of Sheet Metal in Ventilating and Air Conditioning, Warm Air Heating, Industrial Air Handling, Architectural Sheet Metal, Roofing.

SHEET METAL CONTRACTORS NATIONAL ASSOCIATION, INC.

170 Division Street, Elgin, Illinois

FOREWORD

In 1929, the National Association of Sheet Metal Contractors (dissolved in 1933) published "Standard Practice in Sheet Metal Work," a 750 page reference book of standards of practice in fabricating and erecting sheet metal work.

Several years of exhaustive research and study, by scores of men comprising the sub-committee which prepared Sections covering particular phases of sheet metal construction, preceded the actual publication.

Much of the construction shown in Standard Practice in Sheet Metal Work was, at the time of its publication, original material — not to be found in other published literature of the industry. Many of the constructions shown had their origin in the very old craftsmanship brought to this country by the sheet metal artisans who came to America in the last century.

To this basic heritage was added the new materials and new techniques of the first quarter of the twentieth century.

The men who prepared Standard Practice in Sheet Metal Work created even beyond their vision. While the industry has advanced notably in the years since publication of this book, basically most of the constructions shown in Standard Practice in Sheet Metal Work are, today, as applicable as they were in 1929.

Standard Practice in Sheet Metal Work was widely distributed among the architects of the 1930's. But in the 1930's, through a series of circumstances, plates, unbound pages, drawings, manuscripts passed out of existence.

Today, despite the greatly enlarged literature of the industry, there is a growing demand for copies of Standard Practice in Sheet Metal Work. To meet this demand, the Architectural Sheet Metal Manuals Committee of the Sheet Metal Contractors' National Association, Inc., has undertaken the publication of a series of Manuals to replace the former book. Each Manual will deal with one of the major phases of present day sheet metal construction.

These Manuals make use of a large part of the text and drawings from Standard Practice in Sheet Metal Work. Where necessary, original text and drawings will be supplemented by information which accommodates the new materials and new techniques which have become acceptable since 1929.

The Sheet Metal Contractors' National Association has been given permission to use material from Standard Practice in Sheet Metal Work by the heirs of the estate of George Harms, the General Chairman of the Trade Development Committee of the former association. This permission is sincerely appreciated.

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ACKNOWLEDGMENT

This Manual of construction for sheet metal work is made possible only because of the foresight and immeasurable labors of the members and section chairmen of the Trade Development Committee of the former National Association of Sheet Metal Contractors and the guiding spirit of these farsighted committeemen—the General Chairman—the late George Harms of Peoria, Illinois.

Through his untiring efforts, Standard Practice in Sheet Metal Work developed from a dream of the industry into a reference guide of proper construction for sheet metal contractors and the architects and engineers who design and specify sheet metal work.

Through his willingness to contribute financially, far beyond his just share, Standard Practice in Sheet Metal Work was printed and is recognized as one of the monumental books of the construction industry.

So that these services which George Harms gave so generously to this industry may be for all time perpetuated in the minds of his fellow sheet metal contractors and those who buy our services, the Sheet Metal Contractors' National Association, Inc., hereby dedicates this Manual to the memory of the man who wrought so well to establish the sheet metal industry on a high plane—

GEORGE HARMS

1860—1945

Contents

Introduction

Part 1—Skylights

The dictionary defines a skylight as a "window in a roof." Since the light delivered through sidewall, sash or windows is effective for only a limited distance in from the walls, roof windows or skylights have been employed for generations to deliver daylight to interior spaces.

Because the skylight is placed in the highest part of the interior, ventilation for smoke or heat removal is frequently incorporated in the skylight. Such ventilation is most often obtained by construction which permits parts of the skylight to be opened.

Skylights can be fabricated in the average sheet metal shop equipped with a hand brake. Some skylights, because of size or dimensions, must be fabricated in power machinery. Some forms of skylight members may require the use of forming dies in power machinery.

In recent years "extrusions," particularly of aluminum, have been used in place of the formed sheet metal members.

Basically, a skylight is a metal framework designed to support glass or plastic sheets. Depending on whether the skylight is a simple rectangle or a pitched top with hips, the members comprising the skylight framing may be simple or complex, but in either case well within the fabricating means of the sheet metal contractor.

There are on the market today, numerous skylights fabricated by manufacturers specializing in the production of skylights. Some of these manufactured skylights are patented.

Second only to the importance of being a "window," the skylight construction must provide weather tightness. The skylight must be fabricated for water tight connection to the roof. This means proper framing and curbs. Because most skylights use panes of glass of relatively small dimensions, these panes of glass must be water tight and this brings forth the many types of "sash bars" sometimes called "glazing bars." If there is any important difference between one skylight and another, the difference most often is in the design of the glazing bar.

The following pages and drawings in Part 1 of this Manual illustrate most of the common constructions for frames and bars.

One quarter inch thick glass, either plain or wired, is generally used in skylights. On page 45 of this Manual there is a brief treatise on glass characteristics and on page 46 a brief treatise on "plastics."

Where skylights are located in light courts or are adjacent to higher buildings, protection against damage by falling objects must be considered. The usual form of protection is a screen or wire guard above the skylight. Such guards must be removable to permit cleaning of the skylight glass.

Hinged Scuttle Skylight

Drawing No. 1

Drawing No. 1 shows the details of a hinged scuttle skylight on a wood frame. The skylight should be constructed of 24-gauge galvanized iron or 16-oz. cold rolled copper. If galvanized iron is used, then the wrought iron hinges are galvanized. With the use of copper, the hinges are made of hard band brass of the size indicated on the drawing. The lifting power is applied to the hinged end of the skylight, leaving an unobstructed opening for passage. Fig. 1, the plan view, shows the hinges and angle iron support under metal curb. A section on the line *A-B,* shown in Fig. 2, indicates where the hinges and angle iron support are placed, to which the lift is attached. The method of notching the ends of this angle iron support where it intersects the curb, is clearly indicated in Fig. 3.

A detailed section on the line *C-D* in plan is given in Fig. 4 and shows how the hinges are secured to both the metal curb and the wood frame. The glass is laid in putty and capped as indicated. The cap is secured by round head brass bolts and nuts, as this facilitates an easy removal of the cap in case of glass breakage.

Large Size Double Pitch Skylight on Structural Steel

Drawing No. 2

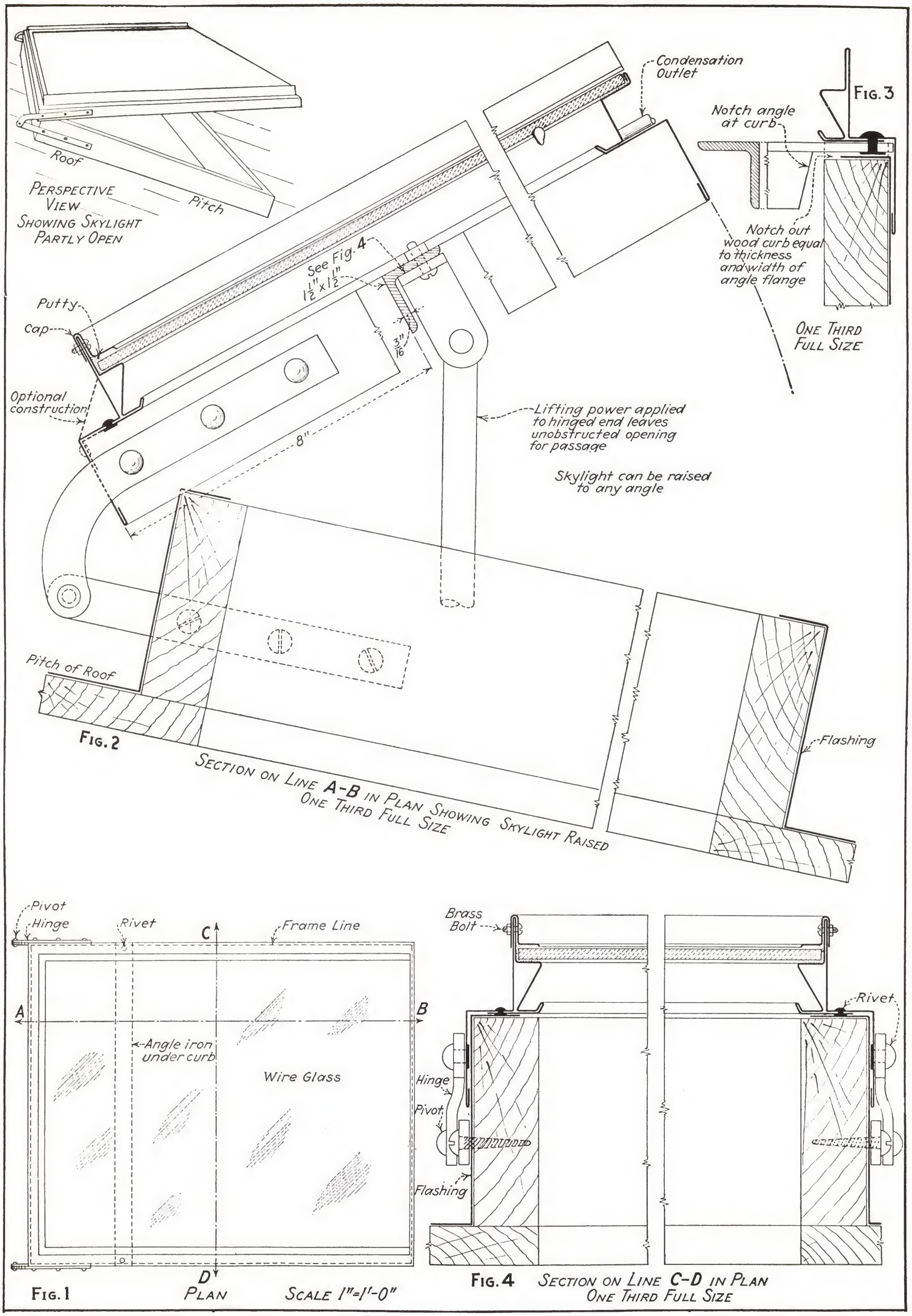
In Drawing No. 2 are shown the construction features when double pitch skylights are erected over steel framing. Attention is called to the dimensions in Fig. 1. Means of supporting skylights of large dimensions require careful consideration, not only to have them support their own weight, but also to withstand the wind pressure and snow loads, as well as the vibration of machinery in factory buildings. While the structural steel engineer takes care of the construction of the trusses and purlins, the engineering task of erecting the skylight is the work of the sheet metal skylight builder.

The curb above the roof line is of concrete topped with a wood plate. The gable wall at each end is of brick covered with a sheet metal coping. In constructing the skylight galvanized iron not lighter than 24-gauge nor cold rolled copper lighter than 16-oz. should be used. The sectional view in Fig. 2 shows the steel cores used in the bars. The weather caps are so designed that they are readily removable for replacing broken glass.

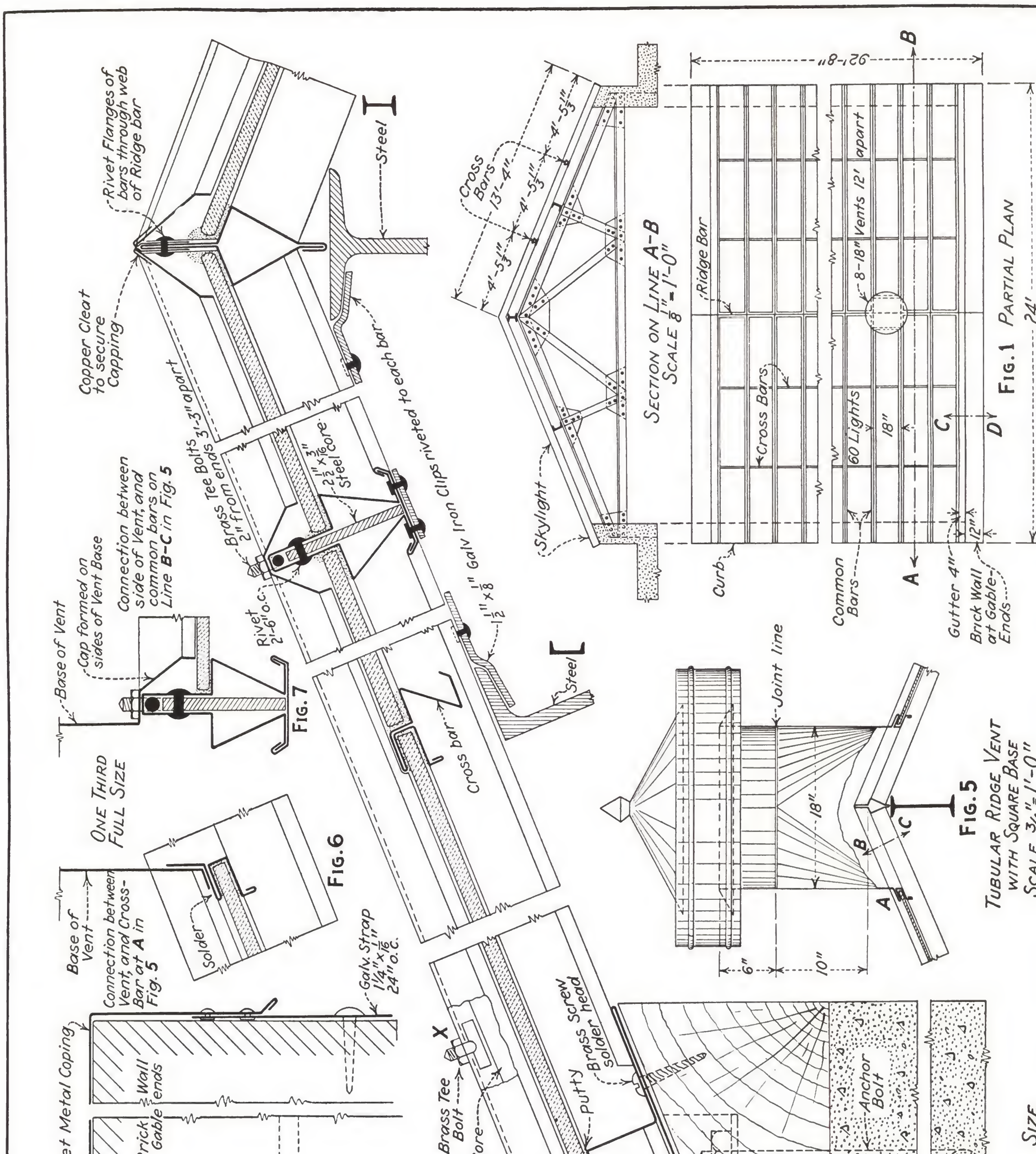
Bronze or hard brass tee bolts with conical point on the threaded end with a hexagon nut are used for fastening the weather cap in place. The bolt, as shown in Diagram *X* and in the bar section, is attached to the web of the bar by punching a hole at the top of the web, and inserting the bolt before placing the steel core in the bar. Each bar is secured to the steel purlins by galvanized steel clamps, as indicated, which hold the bars rigid and prevent any vibration. Where the bars intersect at the ridge, the flanges of the web of the common bar, on each side, are riveted through the web of the ridge bar, making a solid compact joint. The bottom of the bars are soldered to the sheet metal curb, which in turn is secured to the wood plate by brass screws. If it is desired to rivet the bars to the metal curb, the latter may be constructed as shown in Fig. 3.

Fig. 4 is a section showing the construction at the gable end. A half bar is employed with a gutter 4 in. wide, that turns up against the brick wall and forms a base flashing which in turn is capped by the sheet metal coping covering the gable wall.

To prevent condensation, 18-in. tubular ventilators, shown in Fig. 5, are used, setting them 3 ft. from ends and about 12 ft. apart. The waterproof connection of the ventilator with the glass is indicated at *A*, shown in detail in Fig. 6. Fig. 7 shows the detailed connection between the side of the ventilator and common bars, on the line *B-C* in Fig. 5. This principle of construction can be applied to any size skylight.

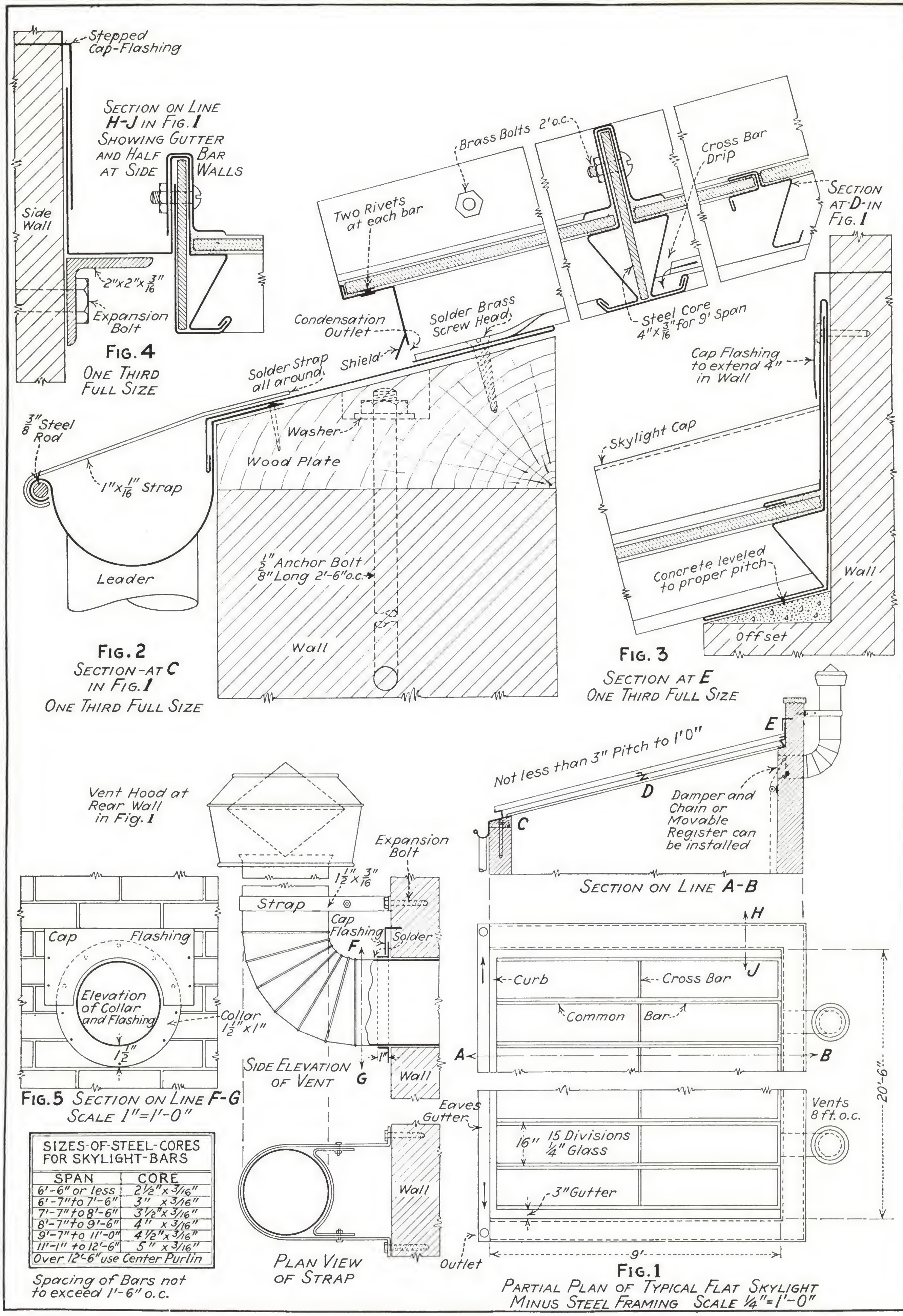


Drawing Number **1** HINGED SCUTTLE SKYLIGHT



DRAWING NUMBER **2**

LARGE SIZE DOUBLE PITCH SKYLIGHT ON STRUCTURAL STEEL



SIZES OF STEEL CORES FOR SKYLIGHT BARS

SPAN	CORE
6'-6" or less	2½" x 3/16"
6'-7" to 7'-6"	3" x 3/16"
7'-7" to 8'-6"	3½" x 3/16"
8'-7" to 9'-6"	4" x 3/16"
9'-7" to 11'-0"	4½" x 3/16"
11'-1" to 12'-6"	5" x 3/16"
Over 12'-6" use Center Purlin	

Spacing of Bars not to exceed 1'-6" o.c.

Drawing Number 3

FLAT SKYLIGHT OVER ELEVATOR AND STAIR SHAFTS

Flat Skylight over Elevator and Stair Shafts

Drawing No. 3

A typical construction where the shaft is of such size that no structural steel is required for the support of the skylight is shown in Drawing No. 3. The appended table gives the size of the steel core plates and the length of the span for skylights up to 12 ft. 6 in., the size limit requiring no purlin for its center support. A skylight with span over 12 ft. 6 in. should be supported by structural steel to take care of the wind pressure and snow loads.

Fig. 1 is a typical example of a flat skylight having a span of 9 ft., regardless of the length. Particular attention is directed to the construction shown in the sectional view at *E*. The wall is offset to receive the bearing of the upper end of the skylight bars and ventilators are placed at the upper end as indicated. Fig. 2 shows the details of construction. The eaves gutter and skylight curb are made in two parts, which allows for the expansion and contraction of the metal, particularly if sheet copper or zinc is used. The common bar has a steel core 4 in. wide, as specified in the table, and both the core plate and the weather cap are secured by brass bolts and nuts.

Each bar is riveted to the curb with two rivets and secured to the wood plate with brass screws whose heads are soldered. The section of the cross bar is clearly indicated, showing how the drip or any leakage from the cross bar is drained to the gutter of the common bar. The brick offset, shown in Fig. 3, is leveled off to the proper pitch with concrete. The formation of the upper curb combines the base flashing and weather cap, this curb being capped by the cap flashing built into the wall as indicated. Fig. 4 shows the section at the end walls with the gutter and half bar attached. A gutter at the end walls has the advantage of draining any water dripping down the side walls, thus preventing the staining of the skylight glass.

The scale details of the ventilator in Fig. 5, show the watertight connection where the ventilator enters the wall. The cap flashing is set over the collar, as shown in the elevation, to make a weather tight job. The method of securing the ventilator to the wall with the metal strap is clearly indicated in the side elevation and plan.

Flat Extension Skylight with Ventilating Sash

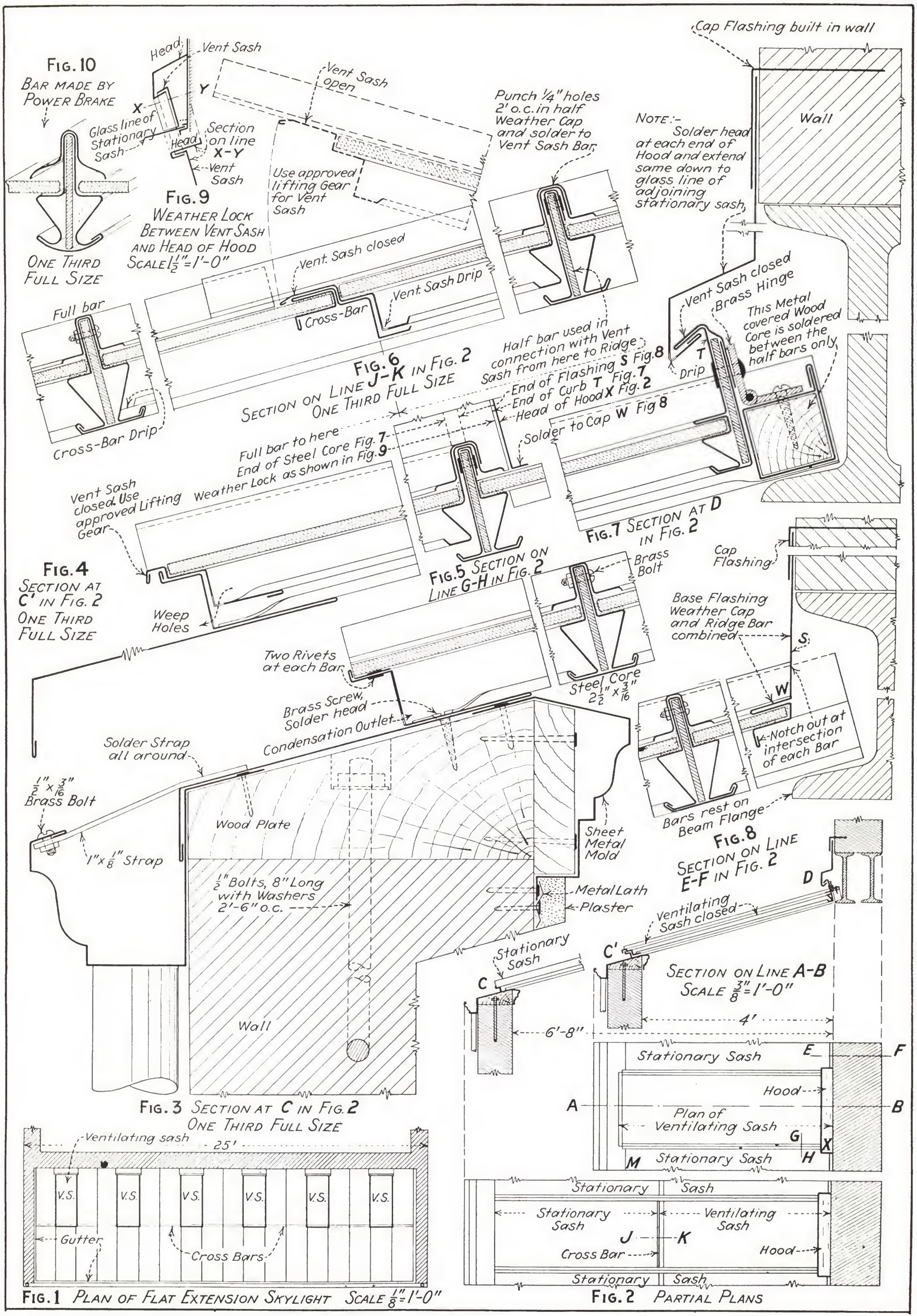
Drawing No. 4

The construction details in Drawing No. 4 show a large flat skylight with ventilating or lifting sash, operated by approved gearings. On this drawing Fig. 1 shows a plan with alternate ventilating sash from the cross bar up to the ridge, more clearly indicated in the partial plan in Fig. 2.

When the span of these extension lights is not too great, the ventilating sash may be made from the curb up to the ridge, as indicated in the sectional view at *C′*. Fig. 3 is a one-third full size working section at *C* in Fig. 2, and shows the ogee gutter, the skylight curb and the inside sheet metal mold. The joints are so made to facilitate erection and at the same time provide for expansion and contraction. Fig. 4 is the section at *C′* in Fig. 2 and makes clear the construction of the ventilating sash when it is carried down to the curb of the skylight. Note the construction of the half bar in Fig. 5 which is used only in connection with the lifting sash, and over this half bar the side muntin or bar of the lifting sash is fitted, with its combined weather cap, being a section on line *G-H*, Fig. 2.

Fig. 6, a section on the line *J-K* in Fig. 2, shows when its lower part intersects the cross bar. When the lifting sash does not run down to the curb, it is necessary to use a full common bar from the curb to the cross bar and a half bar from the cross bar to the ridge, all as shown in Fig. 6. Fig. 7 is a working detail at *D* in Fig. 2. Note that when the sash is closed, the upper part of the curb laps over the hood flange, where weep holes are punched in the angle marked "drip" for the escape of drifting snow. The hinges are of brass as indicated.

Fig. 8 is a section through the stationary sash on the line *E-F* in Fig. 2. Note that the base flashing, weather cap and ridge bar are combined in one and slip under the cap flashing previously built in the wall. Fig. 9 shows the weather lock between the upper part of the ventilator sash and head of the hood. The sections show the sash closed. The various sections show the muntins or bars that have been bent on the hand brake; when the sections of bars are formed on the power brake, they have the form shown in Fig. 10.



DRAWING NUMBER 4

FLAT EXTENSION SKYLIGHT WITH VENTILATING SASH

Curbless Flat Skylight on Pitched Roof

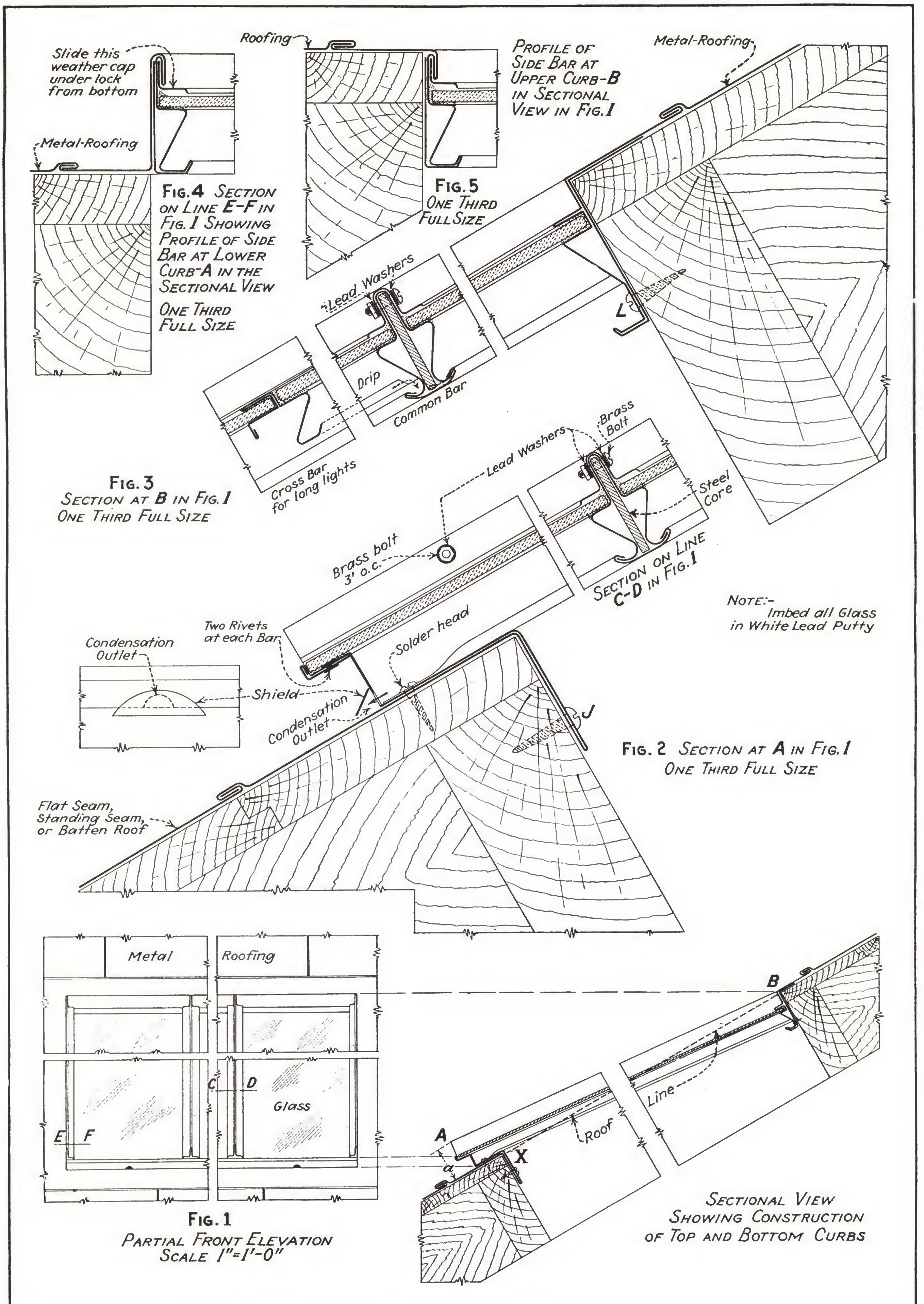
Drawing No. 5

The construction features of a flat skylight where no wood frame or curb projects above the roof line are presented in Drawing No. 5. In the sectional view in Fig. 1, the upper metal curb *B* is set inside of the skylight opening, while the lower metal curb *A* rests above the roof line, to permit the escape of the condensation from the inside. This construction necessitates the tapering of the side curbs from the height *a* of the lower curb to zero at the upper curb, as clearly indicated by *A-X-B*. Fig. 2 is a one-third full size detail at *A* in Fig. 1. The curb is turned down on the inside and secured with screws at *J* to prevent the skylight from lifting. A shield is also placed over the condensation outlet to exclude rain and snow. When fastening the weather cap on the bars, brass bolts with lead washers are used as indicated, so that an absolutely tight joint is obtained. This is required because of the continual flow of water over these parts. The lock on this curb attaches to the metal roofing.

Fig. 3, a section at *B* in Fig. 1, shows the formation of the upper curb. It is also secured to the rafter at *L* to prevent its lifting, and the weather cap is formed in one piece with a lock at the top to which the roofing is attached.

Before inserting the glass under the weather cap, the groove should be filled with white lead putty and the glass snugly imbedded in it. Should the length of the bar necessitate a cross bar, then the form of the cross bar should be as indicated, the drip of the cross bar, if any, flowing in the gutter of the common bar as shown. Fig. 4 is a detailed section on the line *E-F* in Fig. 1, showing the profile of the side bar at the extreme lower end of curb *A* in the sectional view. At this point in Fig. 4, the entire curb is above the roof line.

Note the formation of the lock on the upper part of the bar, in which the half weather cap is slipped from the bottom. The lock to which the roofing is attached is also shown. Fig. 5 shows the profile of this same side bar at the extreme upper end where it miters to the upper curb *B* in Fig. 1. The half bar is similar in both Fig. 4 and 5. The bottom of the bar is flush with the roof line in Fig. 4, to meet the lower curb, then drops in the skylight opening in Fig. 5 to miter with the upper curb, thus bringing the top of the bar flush with roof line.



Drawing Number **5**

CURBLESS FLAT SKYLIGHT ON PITCHED ROOF

Double Pitch Ventilating Skylight

Drawing No. 6

Drawing No. 6 on Page 11 shows details of three "manufactured" skylights of the double pitch type in which both entire sides open and close for ventilation.

Fig. 1 shows a manufactured full ventilating skylight hinged at ridge which may be obtained of galvanized steel, extruded aluminum, sheet aluminum, copper, lead coated copper, Monel or stainless steel. Any flat or ribbed wire glass can be used for glazing. The ridge cap and hood which protects the hinges are shown at the top of the drawing.

A cross section of a typical skylight bar wherein no putty or felt strips or glazing cushions or gaskets are employed to seal the bar and glass is shown in cross section. At the curb or eave of the skylight section, a continuous metal eave is applied to the curb against which the folded back flashing apron with a drip provides a seal against moisture penetration. The operating mechanism may be any one of several types.

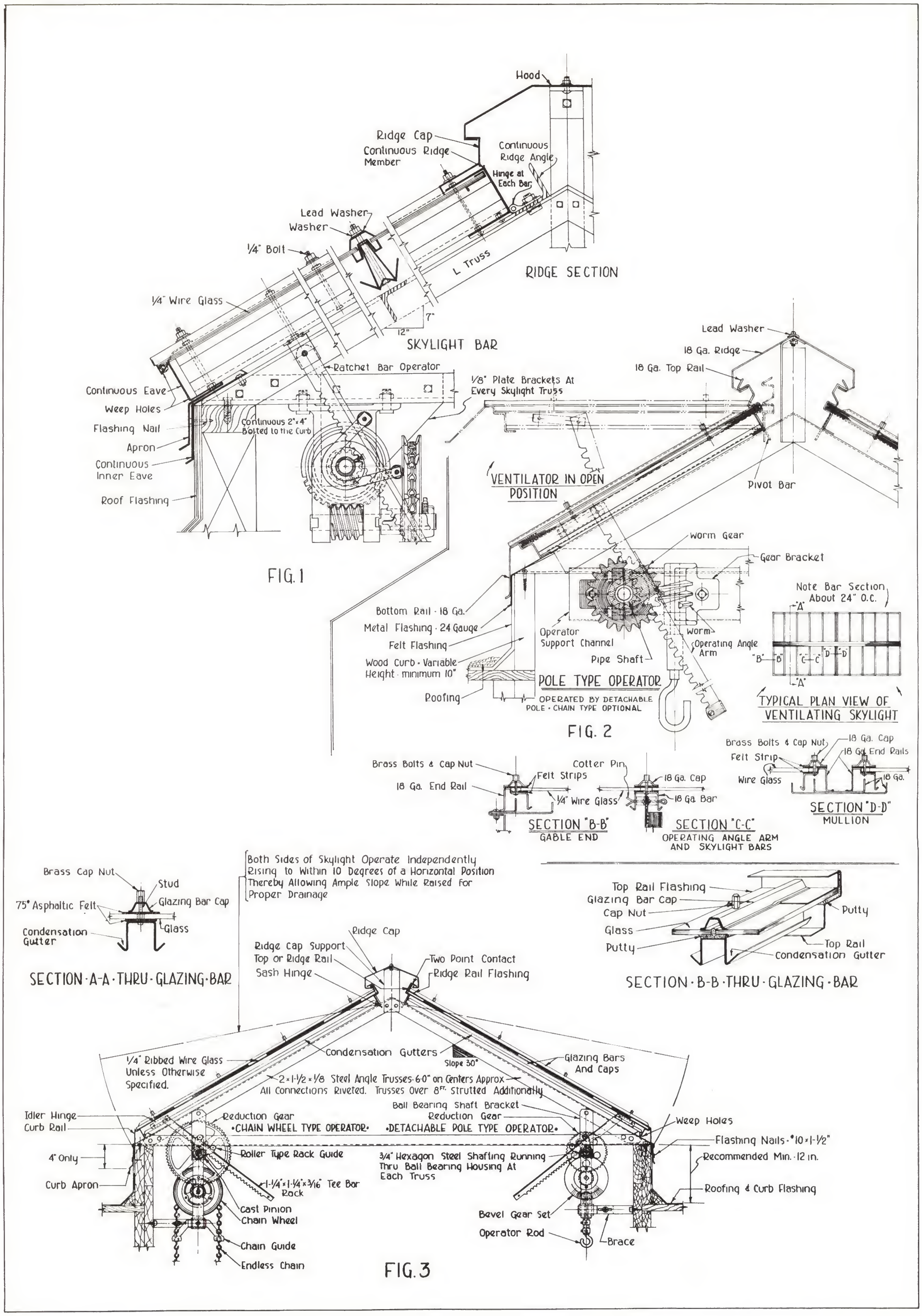
Fig. 2 illustrates another type of manufactured skylight. A ridge hood and cap is again employed using a one-piece construction in which the cap is integral with a top rail which in turn is fastened to the skylight and moves with the skylight. The construction at the eave and curb is similar to Fig. 1.

Detail B-B of Fig. 2 shows the construction at the gable end of the skylight with an inside gutter to carry away water. Section C-C of Fig. 2 is a cross section of a glazing bar also of the puttyless type but an impregnated felt strip is laid under the glass and over the glass and the assembly tightened down by means of glass bolts and cap nuts.

Fig. 3 shows a full cross section of a double pitch, ventilating skylight again using a ridge cap inside of which the ventilating sash moves. The construction of the flashing at the top of the curb is quite similar to the construction shown in Fig. 1 and Fig. 2.

In this skylight a 75 lb. asphaltic strip is used above and below the glass in the glazing bar as shown in Section A-A of Fig. 3, or a construction using putty may be employed as shown in Section B-B of Fig. 3. In both cases the glazing bar cap is held tightly to the glass by means of studs and cap nuts.

Fig. 1 and Fig. 2 and Fig. 3 show three variations of the operating mechanism.



DRAWING NUMBER 6

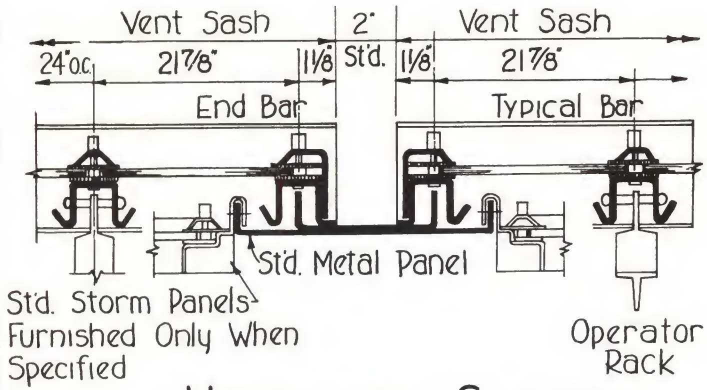
DOUBLE PITCH VENTILATING SKYLIGHT

Single Pitch Ventilating Skylight

Drawing No. 6A

In Drawing No. 6A page 13, are shown the construction features of a continuous single pitch ventilating skylight. The open sash bars may be brake or die formed of 18-gauge galvanized steel, 14-gauge aluminum or suitable weight of copper, depending on the length of sash bar. No solder is used in the assembly of this sash as the bars are cleated to the slotted rails. Curb apron or flashing may be formed of 24-gauge galvanized iron, 20-gauge aluminum or 16-oz. copper. The continuous ridge may be formed of 18-gauge galvanized steel or aluminum and of 20 oz. copper.

A rack and pinion type operating mechanism will hold the ventilating sections rigidly in any position, especially if solid hexagonal shafting is used with malleable iron pinions. If round shaft is used, tighten set screws in pinions so there will be no slippage. The use of brass ball races with hardened steel ball bearings will assure ease of of operation. Racks should be steel Tee or angle sections and should be held in proper contact with the pinions by roller guides. When sash bars are 52 inches or less in length, sash sections up to 40 feet in length may be lifted with one operator. Sash sections up to 30 feet in length are advisable when bars are from 52 inches up to 72 inches long. This type of bar should not be used for ventilating sash much over 6 feet along slope.

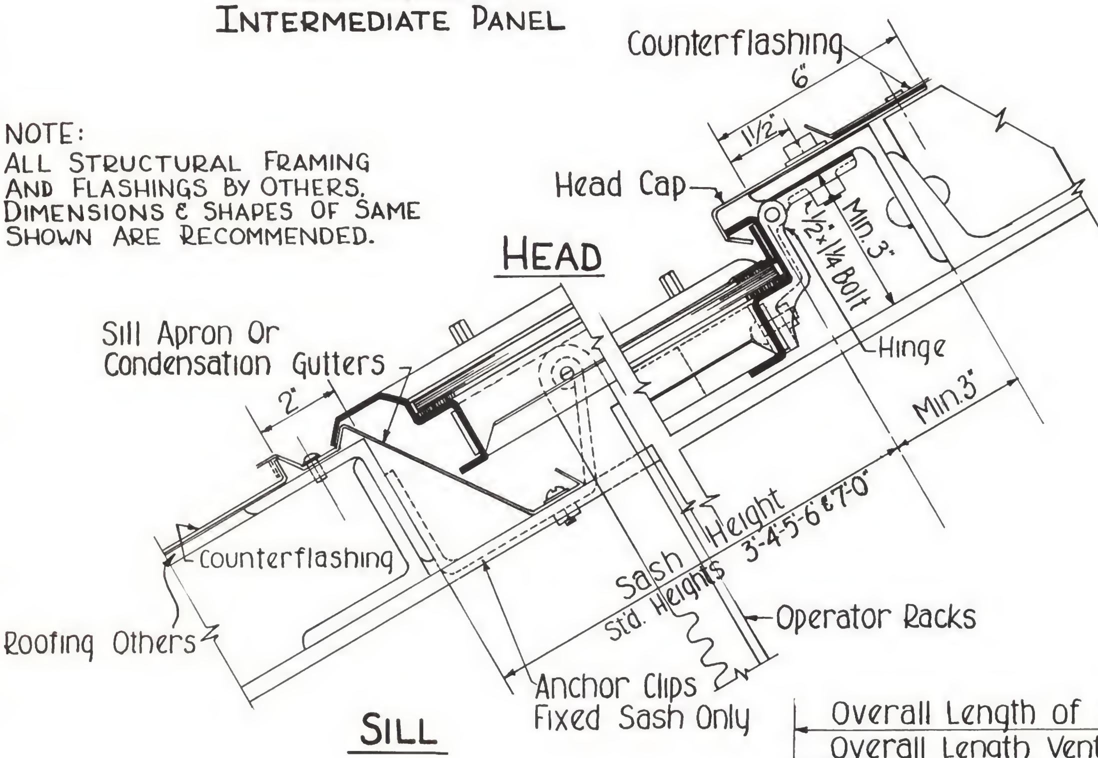


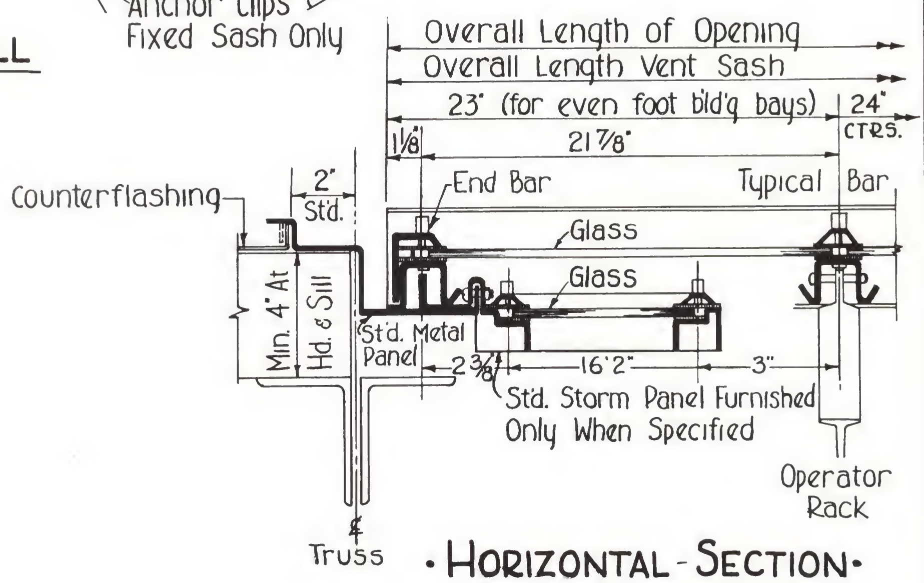
NOTE:
DIMENSIONS SHOWN ARE ONLY FOR ST'D. LAYOUTS WHERE RUNS ARE EVEN FEET IN LENGTH AS 20 FT. 22 FT. ETC.
WHERE RUNS ARE ODD FEET AS 21 FT. 23 FT. ETC. OR IN FRACTIONS OF FEET SPECIAL SPACINGS OF BARS AND SASH ARE NECESSARY

·HORIZONTAL - SECTION·

TYPICAL DETAIL AT INTERMEDIATE PANEL

NOTE:
ALL STRUCTURAL FRAMING AND FLASHINGS BY OTHERS. DIMENSIONS & SHAPES OF SAME SHOWN ARE RECOMMENDED.



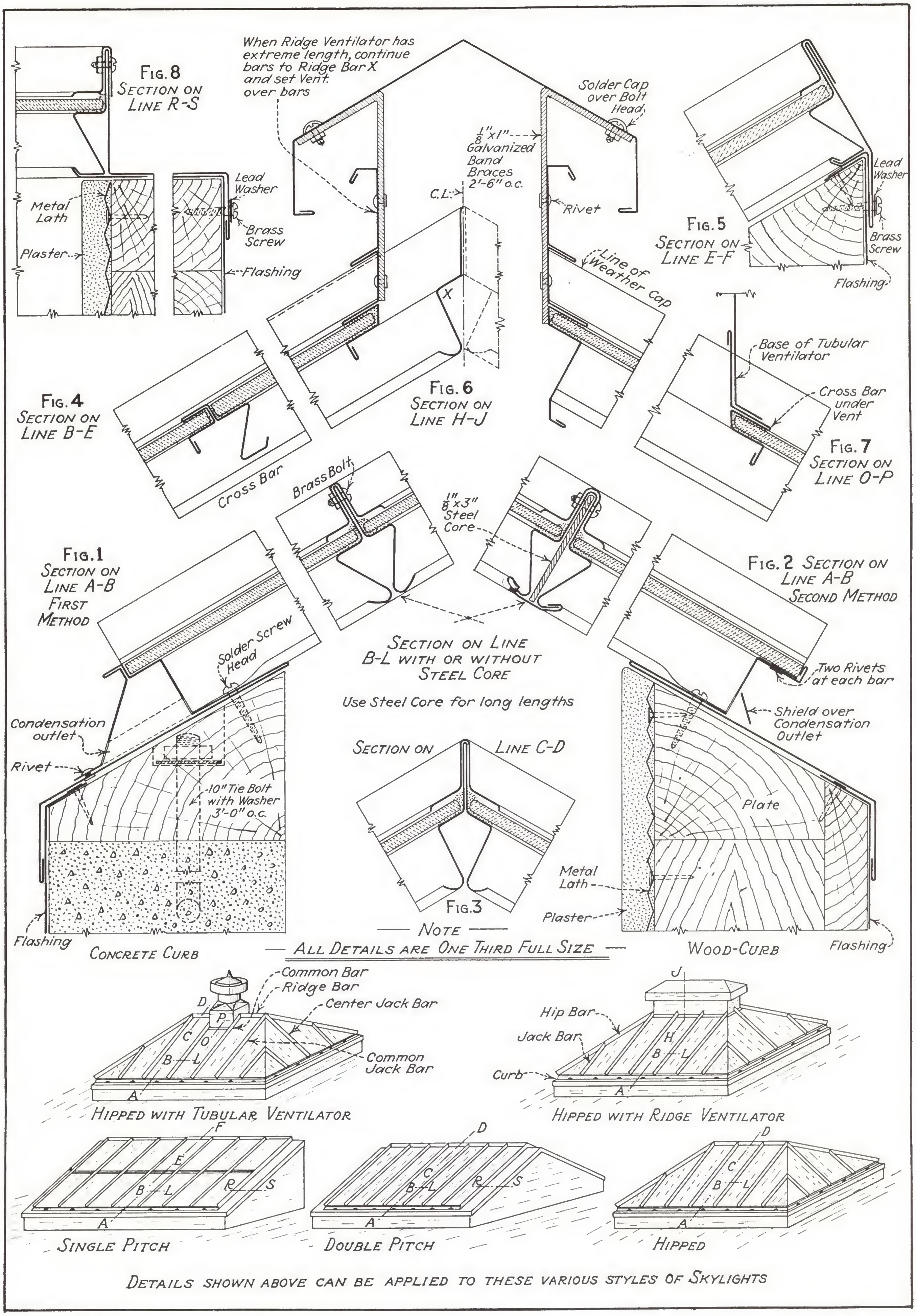


·HORIZONTAL - SECTION·

TYPICAL DETAIL AT END OF RUN

DRAWING NUMBER **6A**

SINGLE PITCH VENTILATING SKYLIGHT



DRAWING NUMBER 7

SINGLE AND DOUBLE PITCH AND HIPPED SKYLIGHTS

Single and Double Pitch and Hipped Skylights

Drawing No. 7

Drawing No. 7 shows construction details drawn to one third full size and indicates the various working sections which can be applied to the different styles of skylights presented in the perspective views. In Fig. 1 and 2 are shown alternate methods of shaping the skylight curb. When the run of the rafter is long, a core plate is placed inside the common bar as shown. Fig. 3 shows the ridge bar which is applicable to both double pitch and hipped skylights. When the skylight is of such a size that the areas of the lights of glass are greater than 720 sq. in., a cross bar is used as shown in Fig. 4. The construction of the skylight curb at the ridge of the single pitch skylight is shown in Fig. 5.

Note the form of this upper curb to insure rigid construction. A round head brass screw and a lead washer are used to secure the curb flange to the frame work. Fig. 6 shows the working details of a hipped skylight with a ridge ventilator. The detail at the right shows the bars connected directly to the ventilator base, this construction being applicable to ridge ventilators not over 4 ft. long. In ventilators of greater length, the skylight bars connect to the ridge bar and the ventilator is set over these bars as shown in the detail at the left.

When a tubular ventilator is used, the glass connection with the base of the ventilator is constructed as shown in Fig. 7. Here the cross bar is inserted separately and the ventilator sets over the upright flange as indicated. Fig. 8 is a sectional detail of the side curb of the single and double pitch skylights. Note the construction of the metal curb, which combines strength and rigidity.

Skylight with Stationary and Movable Louvres

Drawings No. 8-8A

The construction of stationary and movable louvres used with any style of skylight is shown in Drawings No. 8 and 8A which give details drawn to one third full size. A perspective view of a hipped skylight with gutter at the eaves and stationary louvres below is given in Drawing No. 8, and Fig. 1 indicates a section on the line *A-B* of the perspective. In this construction the wood plate over the concrete curb is covered entirely with metal. Note the form of the sill and head. The louvres are flanged, riveted and soldered to the mullions as indicated. The skylight curb and gutter are formed in one piece and secured to the wood core in the head.

Fig. 2 is also a section, and here the metal sill and head have a different construction to avoid inleakage of wind and storm. The solid lines indicate the louvres in closed position while the dotted lines show their position when open. Brackets are riveted to each louvre, and by means of the pivoted strap, the louvres are opened or closed, using spring and racket or any other style of approved gearings. In this Fig. 2 the gutter at the eaves has been omitted as shown, forming the skylight curb with a drip at *X*.

In Fig. 3, in Drawing No. 8A, a section on the line *E-F* in Drawing No. 8, shows the form of the mullions and the connection of the louvres when they are stationary.

Fig. 4 is a similar section when the louvres are movable. It will be noted that the pivot is encased with metal throughout the length of the louvres and operates on brass bushings, and that the vertical gutters in the mullions prevent inleakage of rain and snow. In Fig. 5 is presented a section on the line *C-D* of Drawing No. 8, which shows the form of the corner mullion with stationary louvres. This corner mullion is made in two parts to facilitate the complete construction of each side section of the louvres in the shop, the corners being locked at the building. A similar section in Fig. 6 describes the construction of the corner mullion when the louvres are movable, and indicates a standing lock at *M*, an alternate method from that shown in Fig. 5.

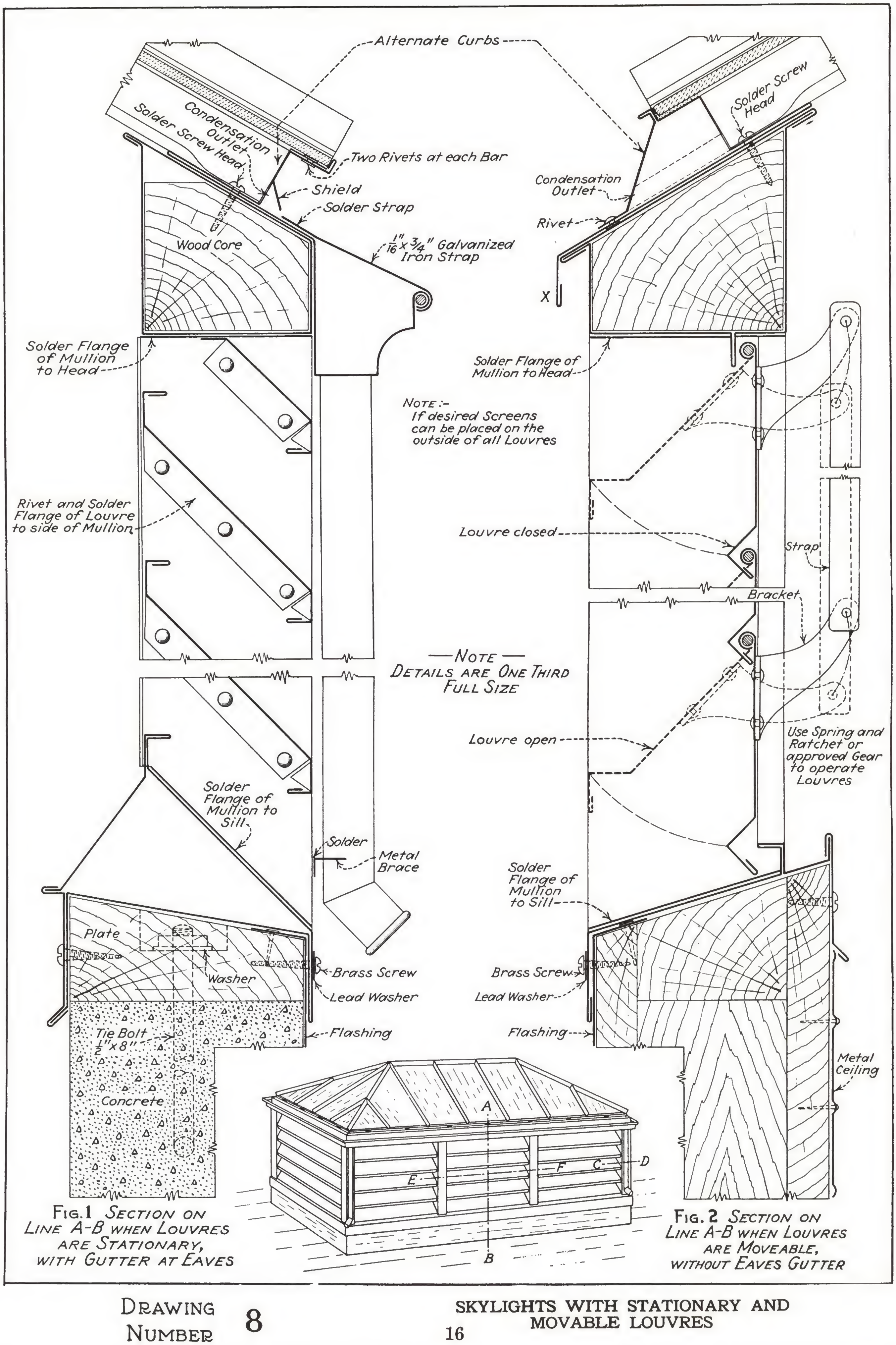


FIG. 1 SECTION ON LINE A-B WHEN LOUVRES ARE STATIONARY, WITH GUTTER AT EAVES

FIG. 2 SECTION ON LINE A-B WHEN LOUVRES ARE MOVEABLE, WITHOUT EAVES GUTTER

DRAWING NUMBER 8

SKYLIGHTS WITH STATIONARY AND MOVABLE LOUVRES

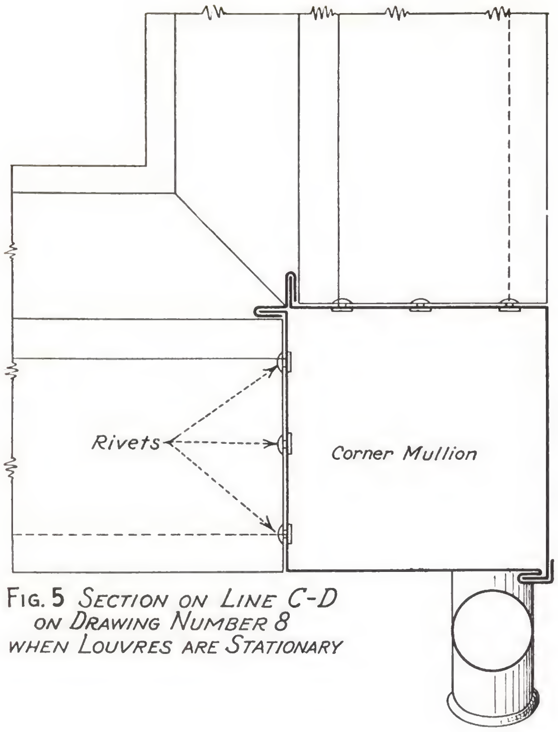


Fig. 5 Section on Line C-D on Drawing Number 8 when Louvres are Stationary

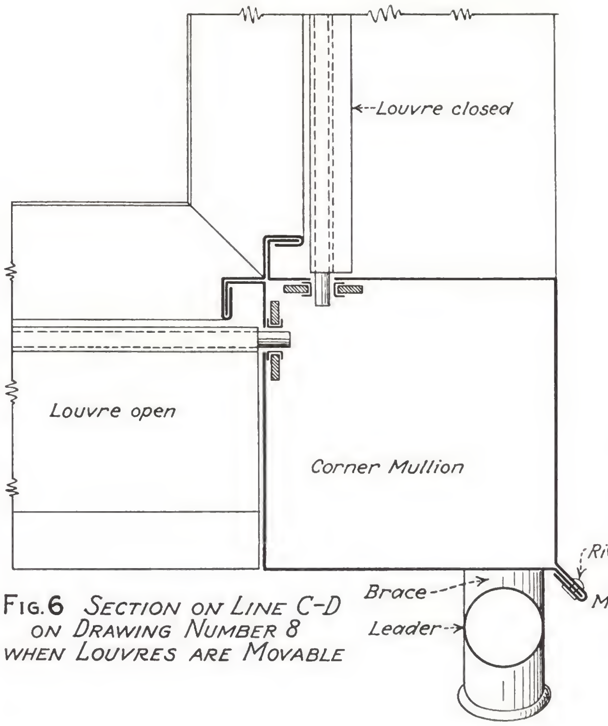


Fig. 6 Section on Line C-D on Drawing Number 8 when Louvres are Movable

Note:- All Details are One Third Full Size

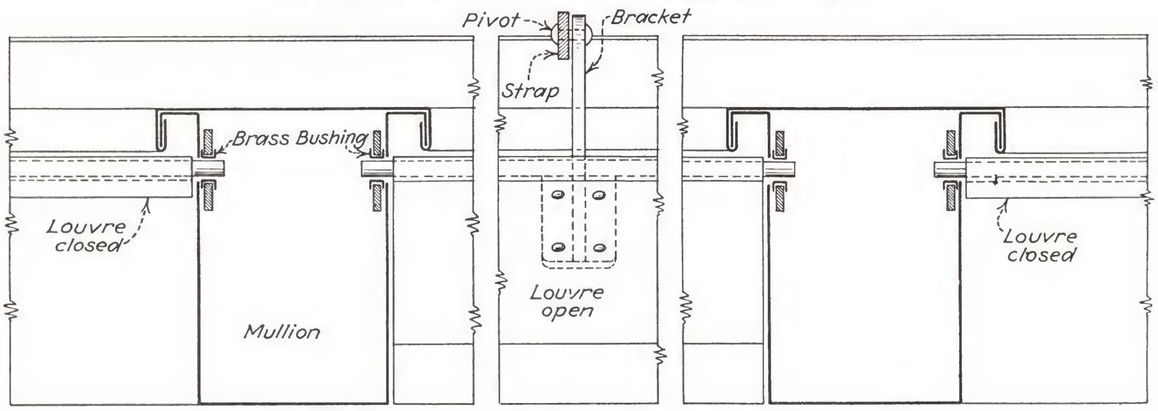


Fig. 4 Section on Line E-F on Drawing Number 8 when Louvres are Movable

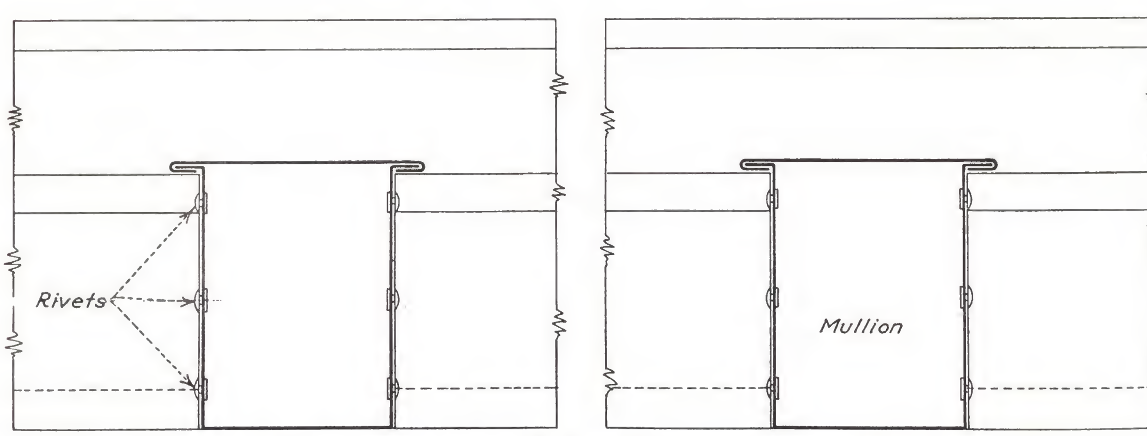


Fig. 3 Section on Line E-F on Drawing Number 8 when Louvres are Stationary

Drawing Number **8A**

SKYLIGHTS WITH STATIONARY AND MOVABLE LOUVRES

Various Types of Movable Turret Sash

Drawings No. 9-9A-9B

To Be Made on Power Brake

The one third full size details for movable turret sash when manufactured on the power brake are given in Drawing No. 9. The perspective view shows the sash topped with a hipped skylight, although frequently they are topped with a single or double pitch skylight. Fig. 1 shows a section on the line *A-B* in the perspective view. In this construction the curb is of concrete with a wood plate anchored as shown. The metal sill has a condensation gutter on the inside connected to condensation tubes as indicated. The sash is constructed to insure against any inleakage from storm and weather.

The skylight curb is combined with an eaves gutter as shown. If desired the eaves gutter is omitted, and the skylight curb formed as shown in Fig. 2. A section through the mullions and sash is shown in Fig. 3, and here the sections above and below the pivots are clearly indicated. The muntin is also shown with screw connection.

To Be Made on a Hand Brake

Drawing No. 9A also shows the details of the ventilating turret sash made on the hand brake. On this drawing the operating device for opening and closing the sash is clearly shown. Fig. 4 is a section on the line *A-B* in the perspective view of Drawing No. 9.

As in the previous drawing the curb is of concrete with an anchored wood plate. The metal sill, sash and skylight curb are formed so that the various parts can be bent on the hand cornice brake with ease. The brackets for the skylight gearings are secured directly to the posts which have wood cores. The sash pivots are of bronze, revolving in bronze plates. The skylight curb varies in construction from that shown in the previous drawing. Note the form of the eaves gutter and its brace. On a large skylight where tie rods are required, if the construction is of wood as shown, these rods are secured in a manner as indicated in the drawing, crossing them if necessary 10 ft. on centers. Fig. 5, a section of the corner post, shows the construction of the sash, above and below the pivot. The form and construction of the muntin is clearly presented. For operating the sashes, the use of either chain, pole hook or hand wheel operating device is recommended. If desired, the gearing brackets can be secured to the roof curb instead of to the post.

Light Construction, To Be Made on Hand Brake

In Drawing No. 9B is shown one third full size details for movable turret sash of light construction, one which is made up on the hand cornice brake, as shown in Fig. 6, a section on the line *A-B* on Drawing No. 9.

The roof curb here is of wood and the metal sill is secured over the roof flashing by screws as shown. The bottom of the sash is arranged for attaching the hinge of the operating device. The posts have wood cores, and a detailed section of the post and sash through the pivot and a section above the pivot are clearly shown. The brass pivot is securely soldered to the post, and the side of the sash through which the pivot passes is reinforced by soldering a brass washer as indicated. Note the form of the upper part of the side sash and the cap which makes the water tight connection.

The skylight curb and eaves gutter are made in one piece, the curb being formed so that the thrust of the bar is directly on to the top rail. A partial front elevation of the upper part of the post, sash and cap is shown. Fig. 7 shows the method of joining the corner posts by the standing lock corner joint. A vertical section through the stationary sash is presented in Fig. 8. Note the form of the posts to receive the glass and the method of securing it.

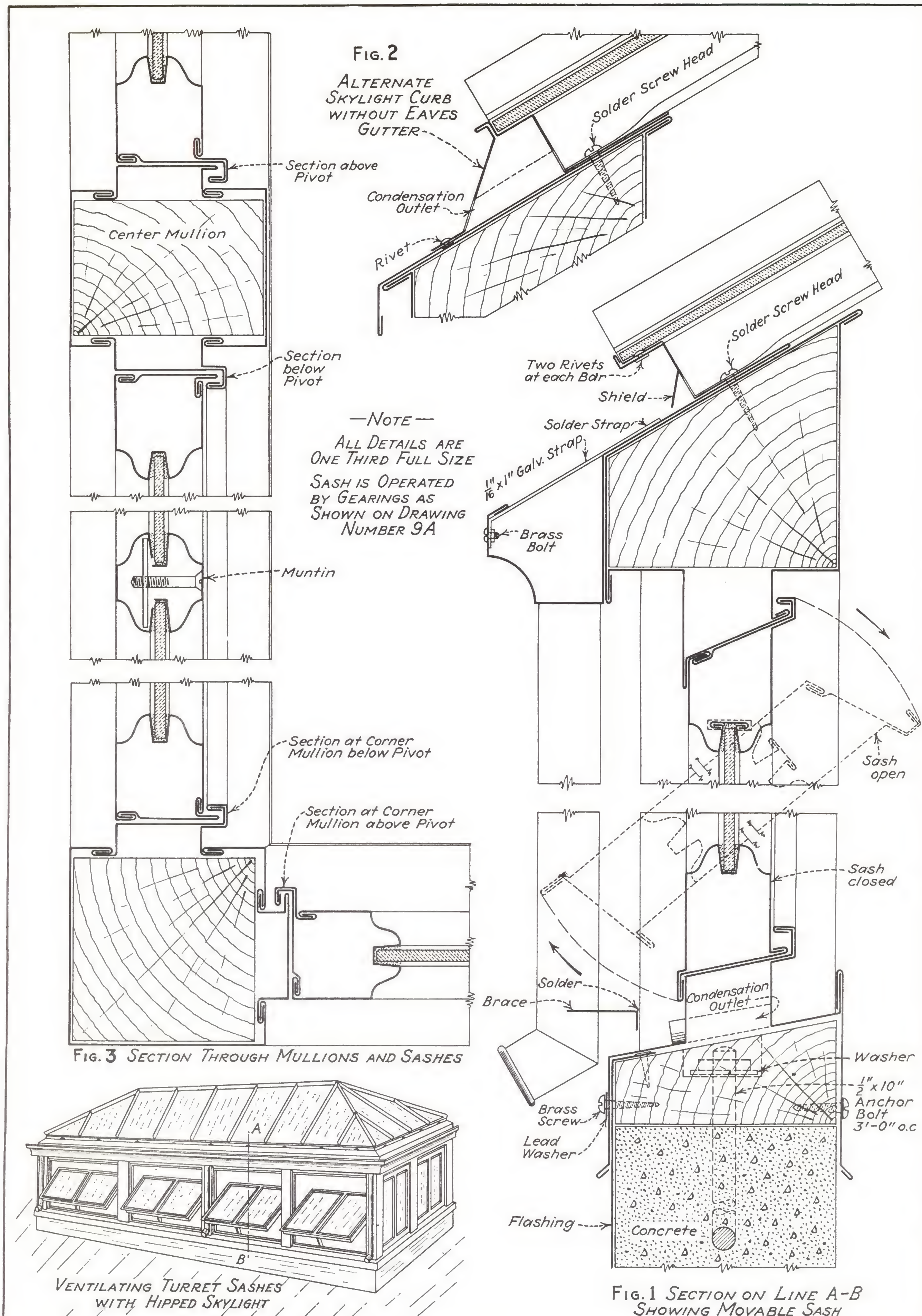


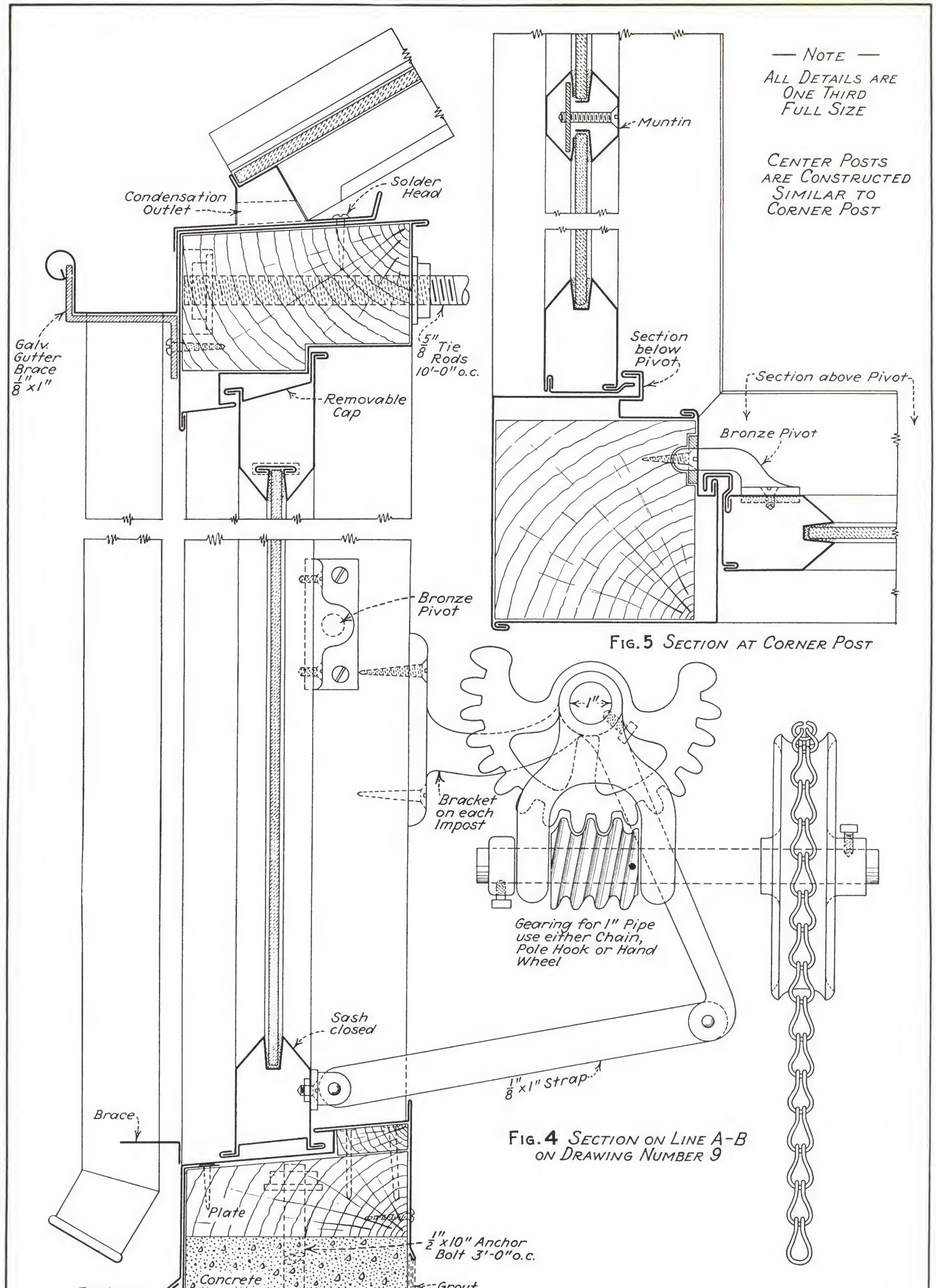
FIG. 3 *SECTION THROUGH MULLIONS AND SASHES*

VENTILATING TURRET SASHES WITH HIPPED SKYLIGHT

FIG. 1 *SECTION ON LINE A-B SHOWING MOVABLE SASH*

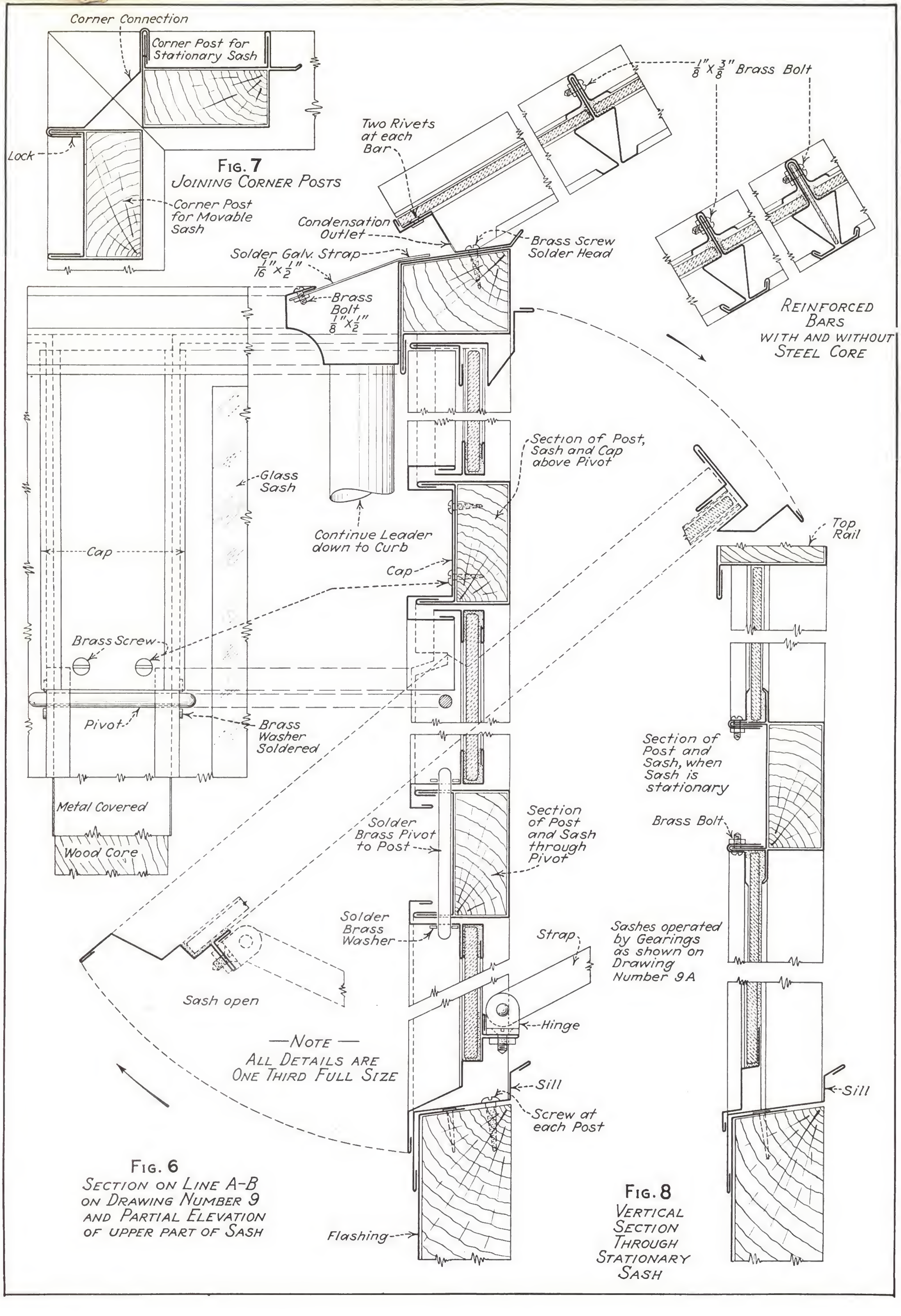
DRAWING NUMBER 9

MOVABLE TURRET SASH MADE ON POWER BRAKE



Drawing Number **9A**

MOVABLE TURRET SASH MADE ON HAND BRAKE



Drawing Number 9B

MOVABLE TURRET SASH MADE ON HAND BRAKE - LIGHT CONSTRUCTION

Stationary Louvres for Brick, Concrete Block, Tile and Wood Walls

Drawing No. 10

Various methods of construction when stationary louvres are to be built in brick, concrete block, tile and wood walls are presented in Drawing No. 10. Fig. 1 indicates the elevation of a pair of stationary louvres with center mullions built in a brick wall and these louvres are made in sizes to fit any opening. A detailed section on the line *A-B* is shown in Fig. 2. In this section the sill of the louvre frame is filled with concrete and the flanges of the louvres are riveted and soldered. When the distance is over 5 ft. between jambs, stiffening straps are riveted in the center.

Fig. 3, a detailed horizontal section on the line *C-D* in Fig. 2, shows at the left the form of the jamb for brick wall and at the right the form of the jamb when concrete blocks are used. The center mullion is also shown. The sill in Fig. 2 can be made hollow without concrete, and used if desired, on brick, stone, concrete or tile walls. When the wall is of wood construction, as shown in Fig. 4, the sill is formed as shown, with an overlapping cap flashing to cover the clap boards or wood shingles, and the jamb is formed as shown in Fig. 5, which indicates a section on the line *E-F* in Fig. 4. Fig. 6 shows the construction of the jamb when the walls are of tile.

Movable Louvres for Brick, Concrete Block, Tile and Wood Walls

Drawing No. 11

In the previous drawing, details for stationary louvres were shown for either brick, concrete block, tile or wood walls. The form of the various jambs shown therein for the different walls is also applicable to Drawing No. 11, which shows one third full size details for constructing movable louvres in a brick wall. Of the two vertical sections, in Fig. 1, one indicates the louvres closed and the other the louvres open. Here the sill is hollow and not filled with concrete as shown in the previous drawing. Note the storm-proof arrangement of the over-lapping louvres.

The brackets are riveted to the louvres with pivoted straps which are operated either by an approved spring ratchet, pulleys or gearing. The drawing at the right shows the position of the louvres when open; these louvres may be constructed to open to any desired angle. Fig. 2 is a section on the line *A-B* in Fig. 1 and shows the louvres in both closed and open position. Note the form of the jamb and center mullion to avoid inleakage at the sides of the louvres. The pivot bearings have brass bushings as shown.

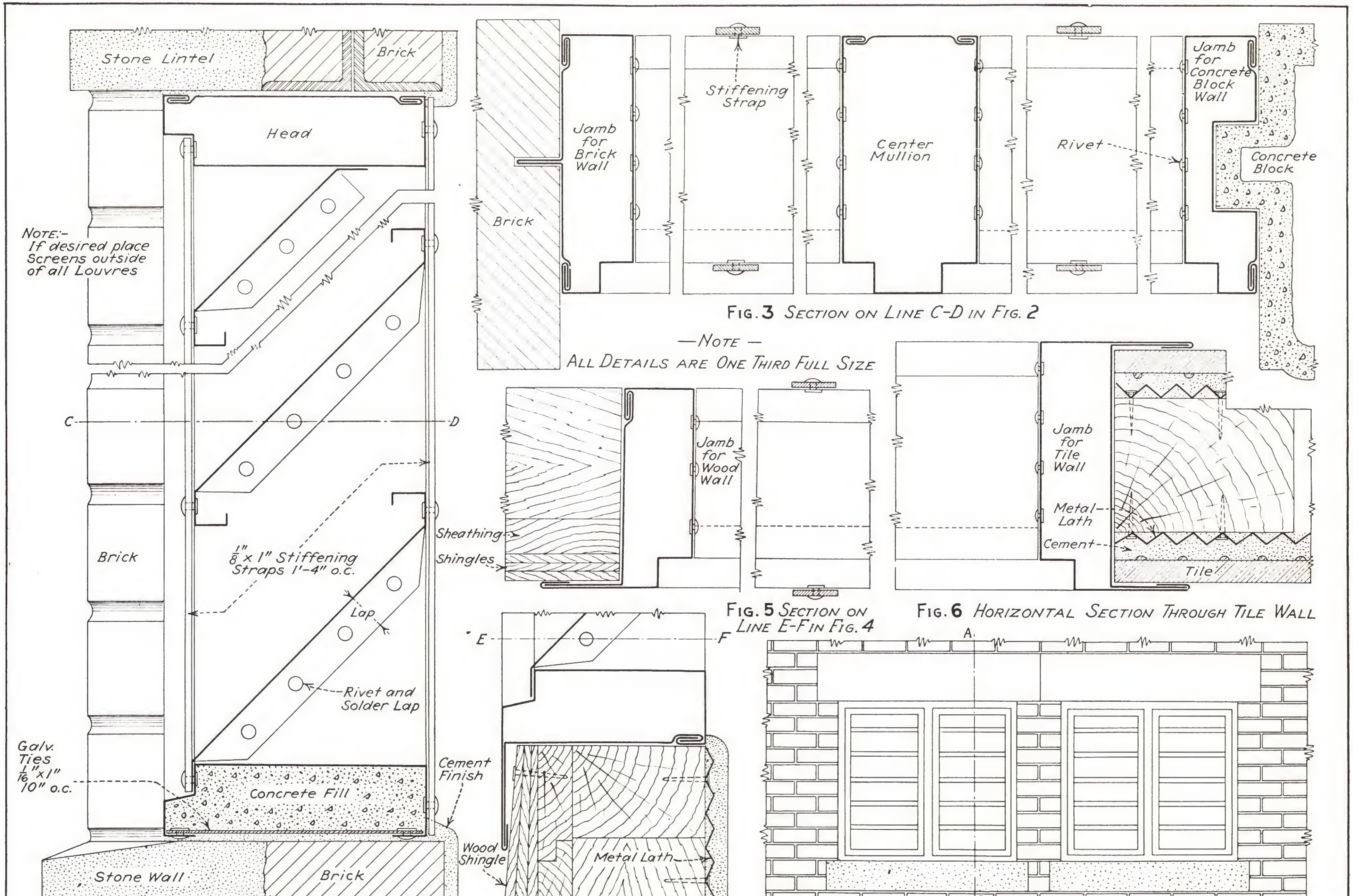


Fig. 2 Section on Line A-B in Fig. 1

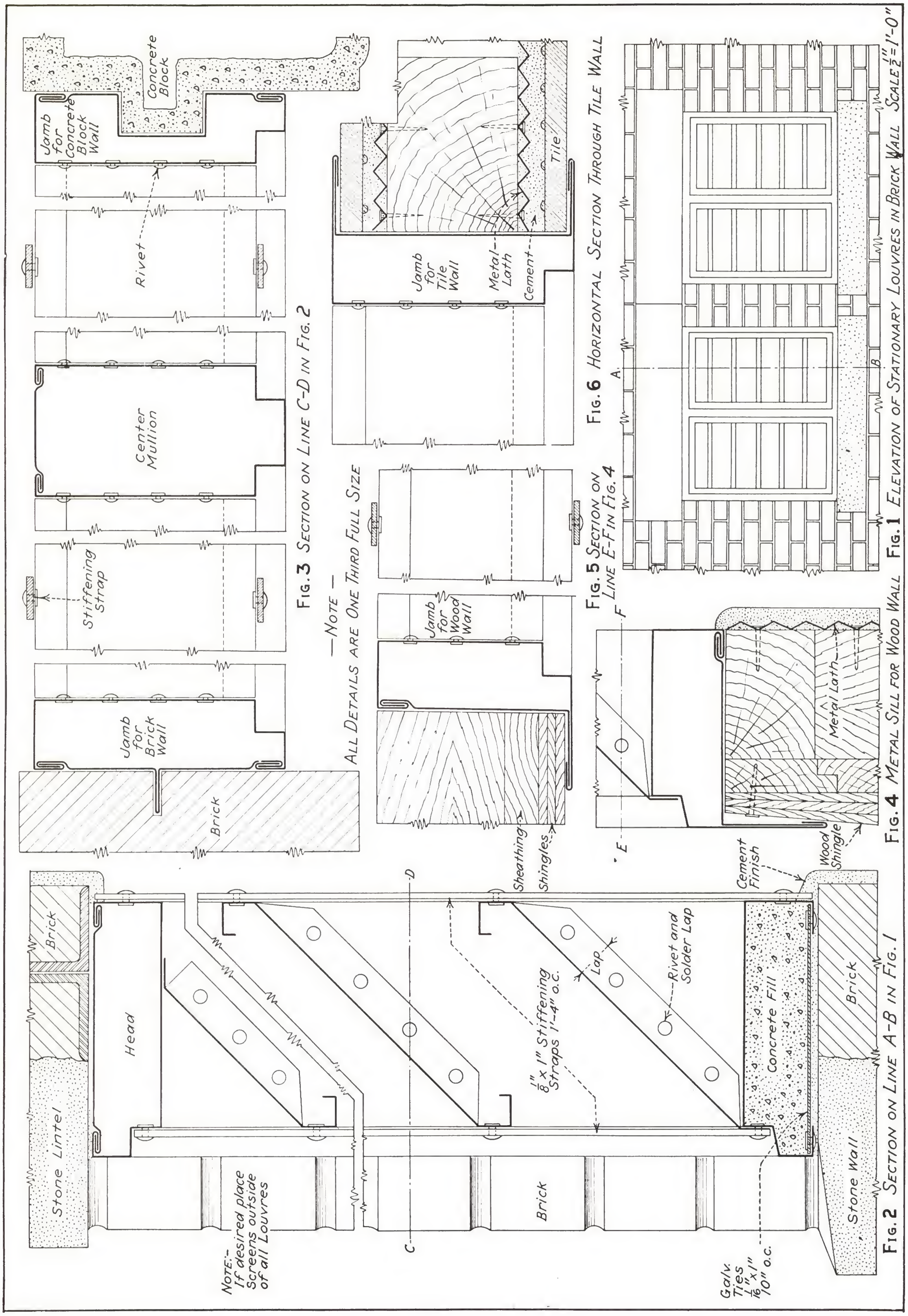
Fig. 3 Section on Line C-D in Fig. 2

Fig. 5 Section on Line E-F in Fig. 4

Fig. 6 Horizontal Section Through Tile Wall

Fig. 4 Metal Sill for Wood Wall

Fig. 1 Elevation of Stationary Louvres in Brick Wall Scale $\frac{1}{2}$"=1'-0"



Drawing Number **10**

STATIONARY LOUVRES FOR BRICK, CONCRETE BLOCK, TILE AND WOOD WALLS

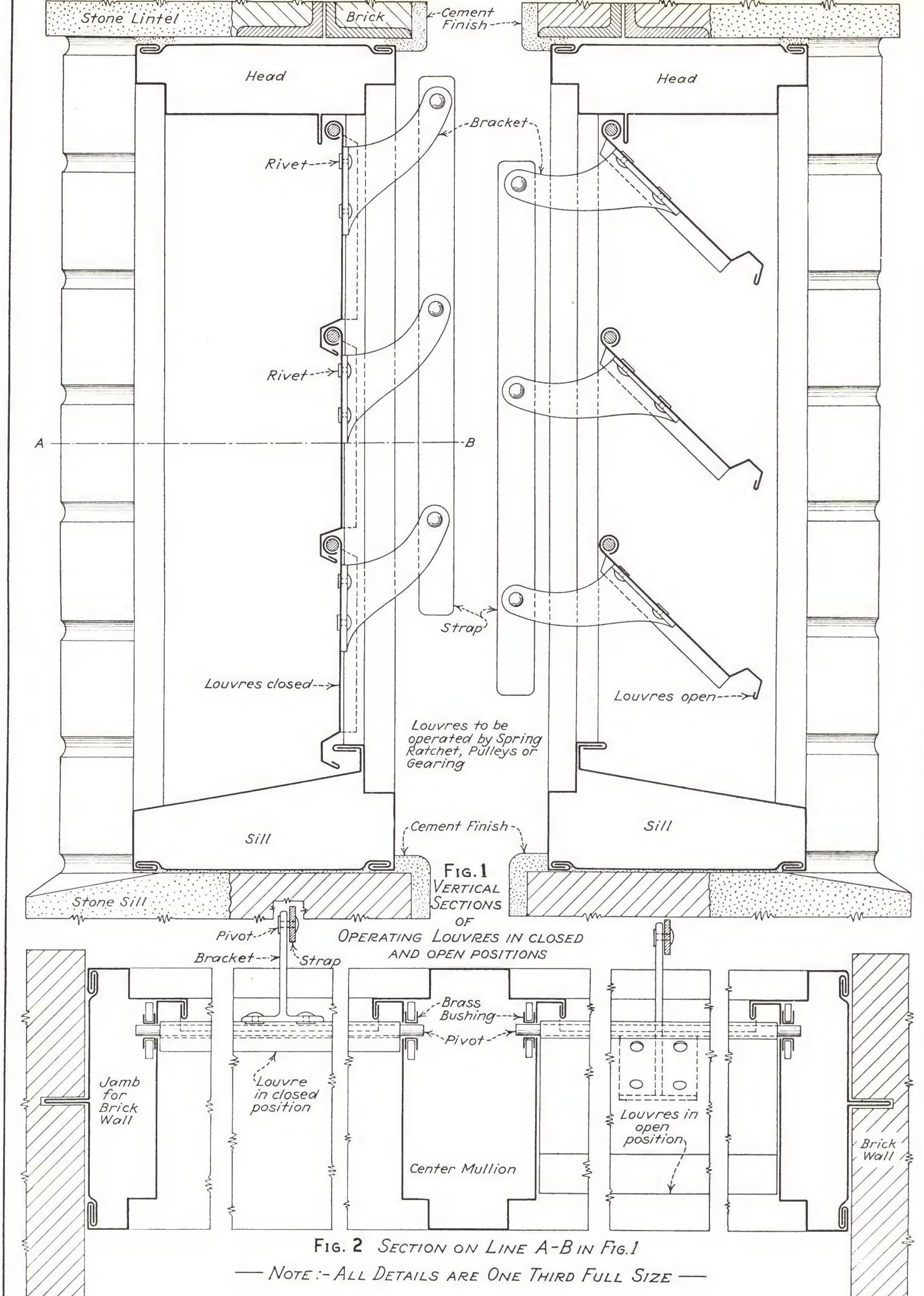


FIG. 1 VERTICAL SECTIONS OF OPERATING LOUVRES IN CLOSED AND OPEN POSITIONS

FIG. 2 SECTION ON LINE A-B IN FIG. 1

— NOTE:- ALL DETAILS ARE ONE THIRD FULL SIZE —

DRAWING NUMBER **11**

MOVABLE LOUVRES FOR BRICK, CONCRETE BLOCK, TILE AND WOOD WALLS

Saw Tooth Skylight with Ventilating Sash

Drawings No. 12-12A

Construction of Skylight

A saw tooth or north light skylight is the subject of Drawing No. 12, with its one third full size details. While the construction of the framing shown is of wood, the same methods of securing the skylight is employed when the construction of the framing is of structural steel. Fig. 1 is a scale drawing showing a partial elevation of the stationary as well as the ventilating sash. A section on the line *X-Y* is shown at the right. When no ventilating sashes are desired, tubular ventilators of similar design and construction as indicated are used.

Fig. 2 represents a working detail on the line *A-B* in Fig. 1. The upper part of the framing at *a* in Fig. 1 is raised above the surface *b* and *c*, as much as is indicated by *T* in the detail in Fig. 2. This is done for the purpose of securing, in a simplified manner, the ventilating sash which is detailed in Drawing No. 12-A. The flashing and skylight cap at the upper part of the skylight are made in one piece as shown in Fig. 2. Fig. 3, a section on the line *C-D* in Fig. 1, shows the form of the skylight bar at the sides. After the roof flashing is secured, the half skylight bar with top flashing combined forms a cap flashing over the roof flashing and is secured with brass screws and lead washers as indicated. The capping over the glass is secured with small brass bolts which do not rust and facilitate the removal of the cap in case of breakage of glass.

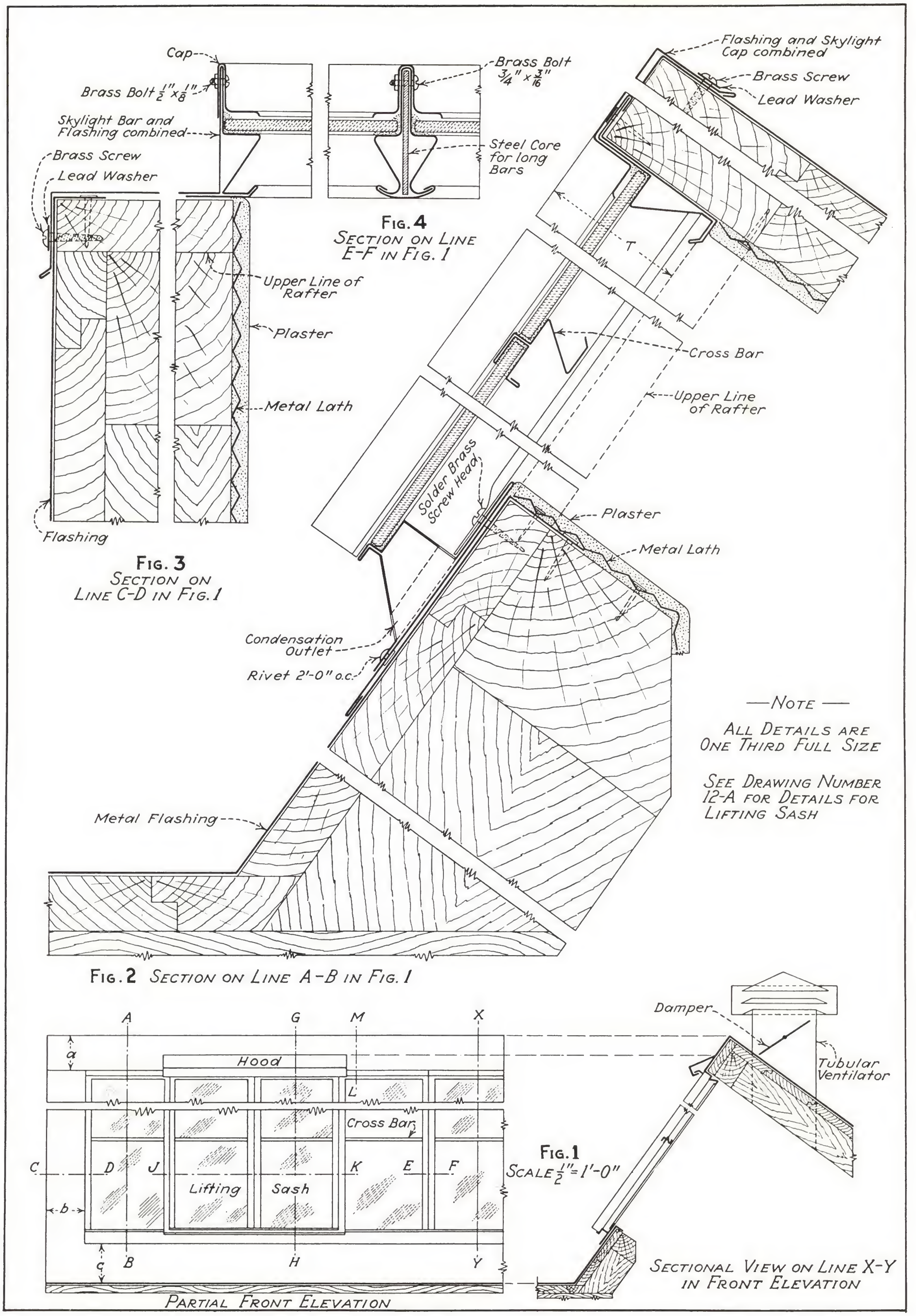
The details of the common bar on the line *E-F* in Fig. 1, are shown in Fig. 4. When the run of the rafter or skylight bar is very long, steel core plates are inserted as shown in Fig. 4, brass bolts ¾ x 3/16 in. being used to secure capping and core. When the inside finish around these north lights are either cement or plaster, metal lath is employed to avoid cracking in the plastered walls.

Construction of Ventilating Sash

Drawing No. 12A, the one third full size details used in connection with Drawing No. 12, indicates the construction of the ventilating or lifting sash. Fig. 5 is a working section on the line *G-H* in Fig. 1, Drawing No. 12. Note the construction of the lower and upper curbs of the ventilating sash. Brass hinges are used, screwed to the wood frame at the top and riveted to the angle iron which is placed around the three sides of the ventilating sash. Note the hood over the hinge with a weathertight joint between the hood and singed curb. A part elevation of the hood is shown at the left with a section on the line *C-D* shown below, indicating the head of the hood and end of operating sash.

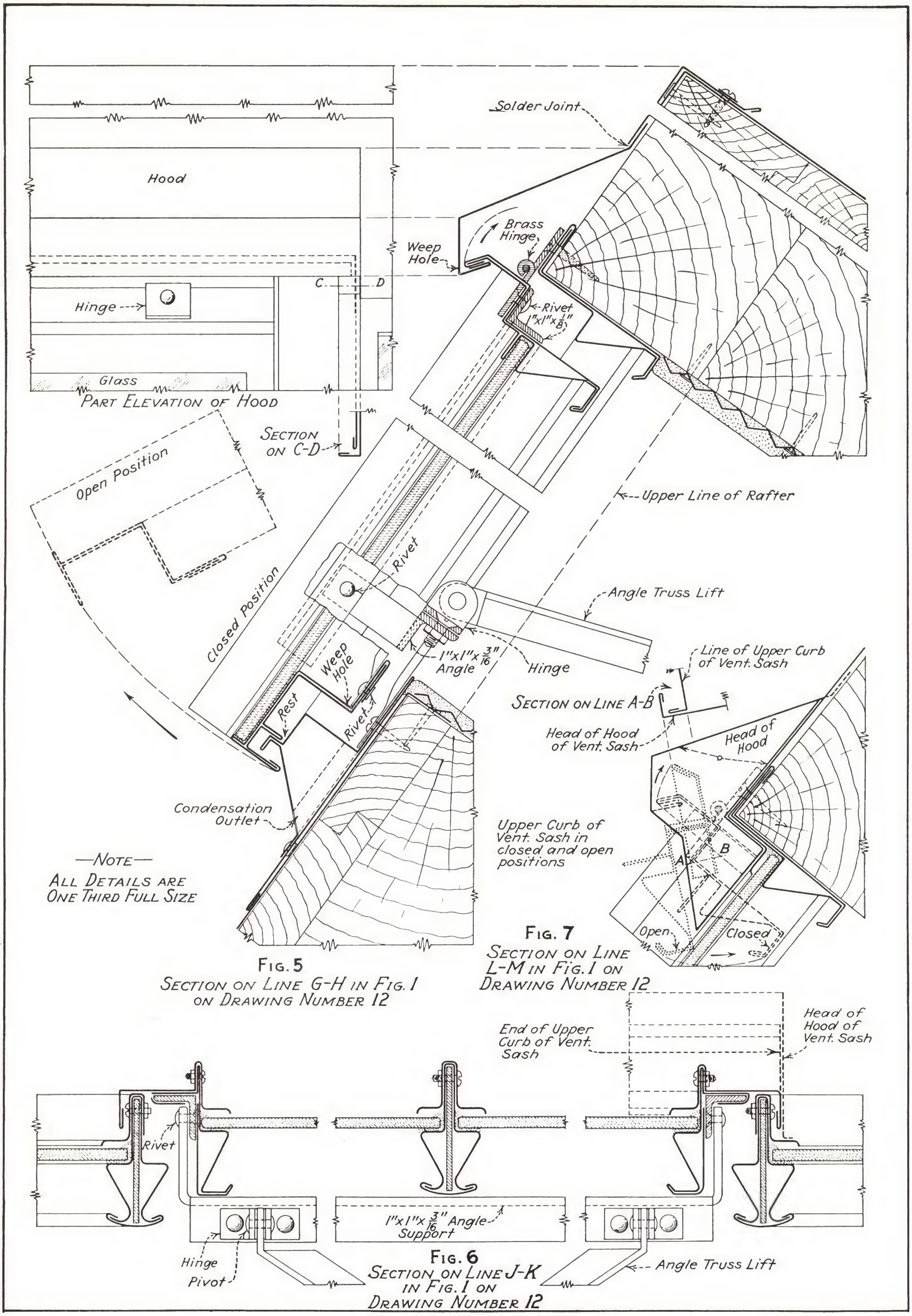
The ventilating sash is raised by approved gearings, on which is used an angle truss lift, bolted and hinged to an angle iron support and riveted to the angle iron frame set in the lifting sash. This construction makes a rigid frame, capable of operating two or more lights at one time. Fig. 6 shows a detailed section on the line *J-K* in Fig. 1. Note in Fig. 6 that the side bars of the ventilating sash lock over the angle iron frame, and that the capping over the glass forms at the same time a cap flashing over the stationary bar. The angle iron support of two or more lights is riveted to the angle frame as shown.

The angle truss lift operated by approved gearing and pivoted to the hinges which in turn are riveted to the angle support, is clearly indicated. Fig. 7, a section on the line *L-M* in Fig. 1, presents the upper curb of the ventilating sash in closed and open positions. The head of the hood is clearly shown, with sufficient material added so that when the sash is open the sides of the ventilating sash will be covered. The operation of the ventilating sash inside the head of the hood is clearly indicated in the section on the line *A-B* shown above the cut. The notes "Head of hood of vent sash" and "Line of upper curb of vent sash" in both Fig. 6 and 7 should be carefully studied as they make clear the construction features.



Drawing Number **12**

SAW TOOTH SKYLIGHT WITH VENTILATING SASH



Drawing Number **12A**

SAW TOOTH SKYLIGHT WITH VENTILATING SASH

Marquise Skylight on Structural Steel Framing

Drawings No. 13-13A-13B

A part plan, front and side elevations of an ornamental marquise with cornice, cresting, panels, glass pendant frames all made of sheet metal and erected on structural steel framing, is shown in Fig. 1, Drawing No. 13. If desired the cresting and pendant frames may be obtained in stamped zinc or copper in elaborate designs. Note that the marquise pitches toward the wall as indicated by the gutter shown in the part of plan.

To show the construction, various one third full size sections are shown on the lines indicated in plan. A detailed section on the line *A-B* or the high end of the marquise is shown in Fig. 2. The panel on the inside of the channel is locked to the bottom of the cornice and the band iron brace of the cornice is bolted to the top of the channel flange. The roof of the cornice is extended to lock over the cross bar of the upper end as shown. The glass rests directly on the inverted tee bars and is well bedded in white lead putty. The cresting shown is hand-made with an opening for drainage as indicated. The glass pendant frames are also hand-made and are screwed to the lower part of the cornice as shown. More elaborate designs may be had in pressed zinc or copper work.

Fig. 3, a detailed section on the line *C-D* in Fig. 1, shows the form of the cross bar over the center channel, which becomes necessary when two or more lights of glass are required in the run of the tee bar. Note the connection at the lower corner of the panel joint. A few brass screws 3 ft. on centers hold this joint rigid. Fig. 4 indicates a section on the line *L-M* in Fig. 1, showing how the metal capping is secured to the tee bar, thus protecting the joint.

In Drawing No. 13A are shown three detailed sections, also drawn one third full size. Fig. 5 is a section on the line *G-H* in Fig. 1, Drawing No. 13. As may be noted, steel angles are used at the sides, capping them as indicated, and permitting the roof of the cornice to extend upward and act as a base flashing. Where the gusset plate of the suspender projects through the top of the cornice, this is flashed as indicated. Fig. 6 shows a detailed section on the line *E-F* in Fig. 1. The channel here projects away from the wall equal to the desired width of the gutter. An angle is riveted to the channel to the required pitch and sheathed as shown, with 45-deg. wood strips inserted, to keep the corners of the gutter clear to permit of free movement of the gutter lining, particularly when copper is used.

The cap flashing should be turned in the wall not less than 2 in. Note the form of the cross bar at the lower end. The space under the gutter is covered with a soffit panel as shown, the molded panel being joined as indicated. An opposite view of this soffit panel on the line *P-R* in Fig. 1 is shown in Fig. 7. These panel heads are locked to the bottom of the cornice and over this lock the glass pendants are secured to the wood blocking.

In Drawing No. 13B, Fig. 8 to 12, are given details of construction when sheet metal bars are used instead of tee bars as shown in Drawings No. 13 and 13A.

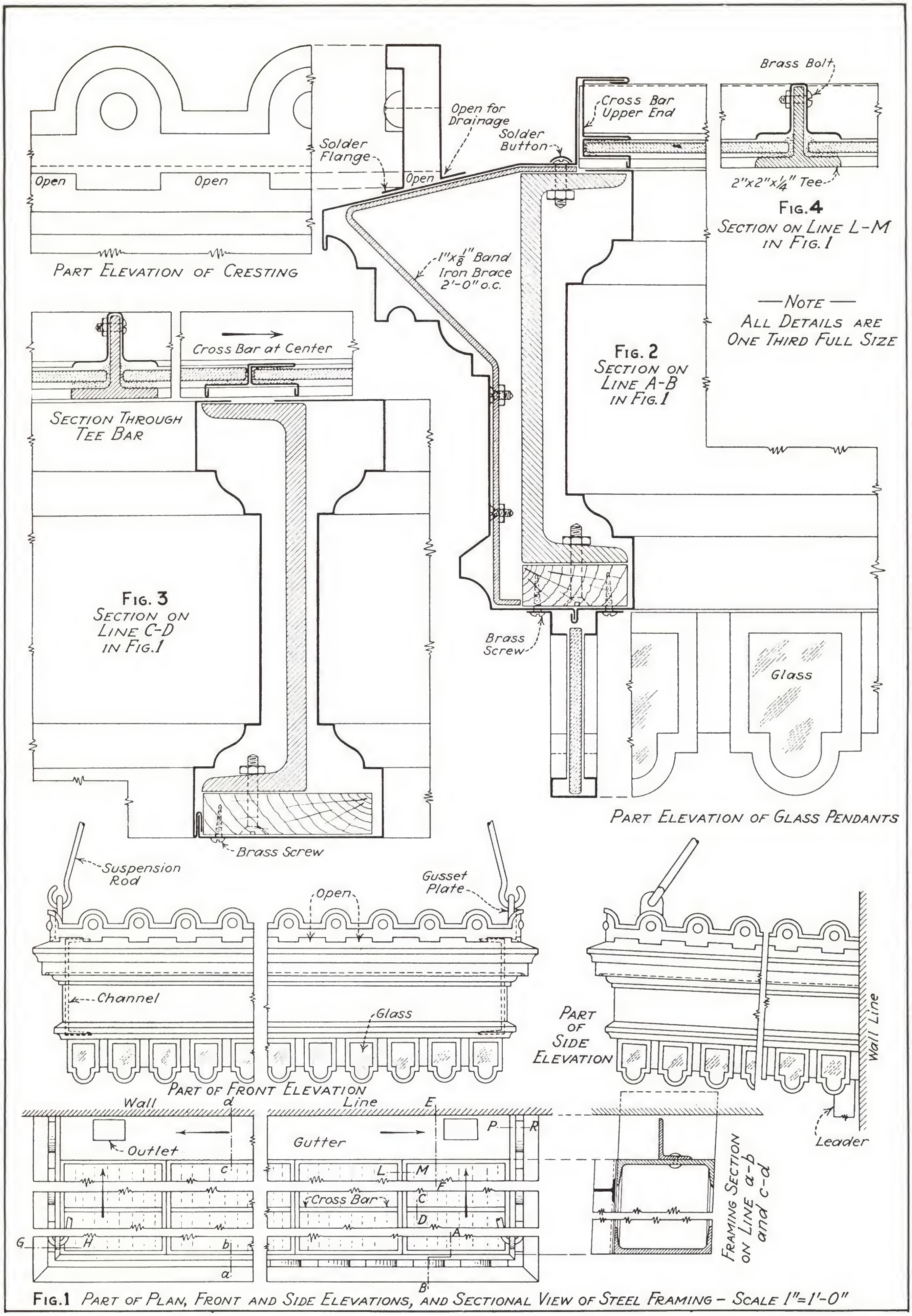


Fig. 1 Part of Plan, Front and Side Elevations, and Sectional View of Steel Framing – Scale 1"=1'-0"

Drawing Number 13

MARQUISE SKYLIGHT ON STRUCTURAL STEEL FRAMING

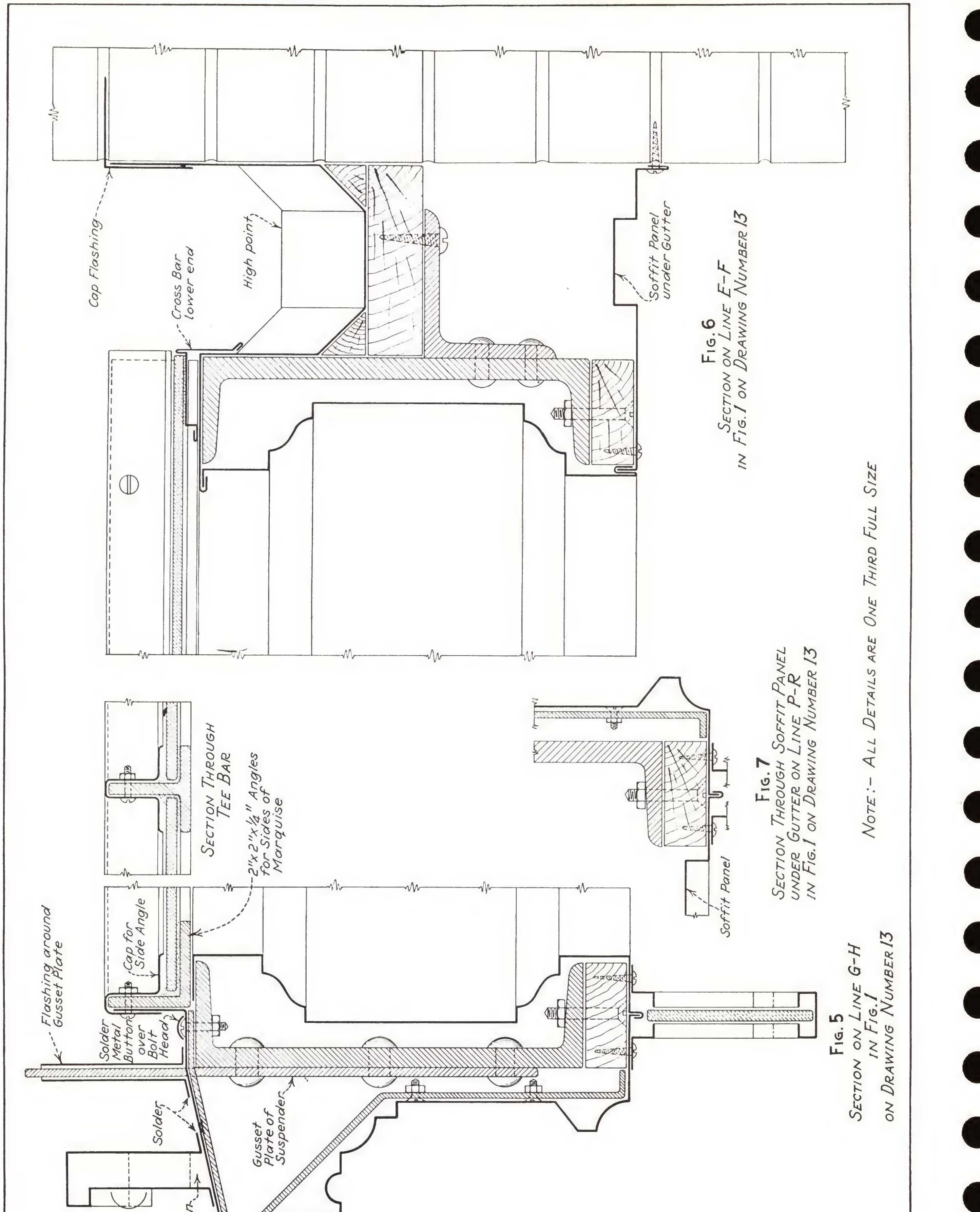
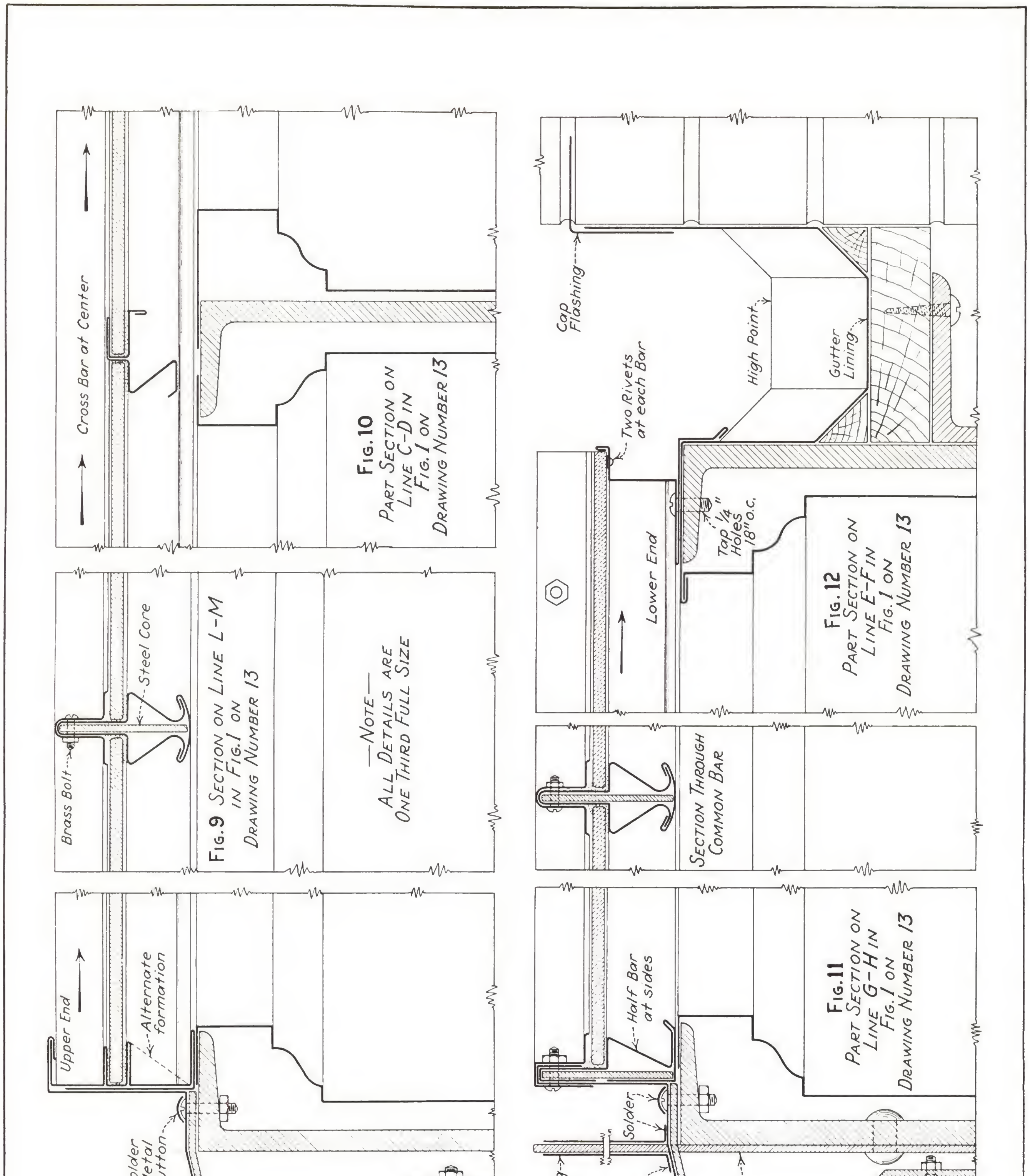


Fig. 6 Section on Line E-F in Fig. 1 on Drawing Number 13

Fig. 7 Section Through Soffit Panel under Gutter on Line P-R in Fig. 1 on Drawing Number 13

Fig. 5 Section on Line G-H in Fig. 1 on Drawing Number 13

Drawing Number **13A** MARQUISE SKYLIGHT ON STRUCTURAL STEEL FRAMING



Drawing Number **13B**

MARQUISE SKYLIGHT ON STRUCTURAL STEEL FRAMING

Aluminum Top Hung Ventilating Sash

Drawing No. 14

Drawing No. 14, page 33 shows typical manufactured extruded aluminum top hung ventilating sash using a brake type operator.

The sash bars, top and bottom rails, are extruded aluminum shapes with the sash bars formed to provide condensation gutters draining through the bottom rail to the outside. The sash members are bolted together using 3/8-in. aluminum cap screws.

Either malleable iron hinges along the top rail, (Section A-A) spaced at 4-ft. centers or top rails so formed as to provide a continuous hinge in combination with the hinge plate (Section F-F) are used.

Sash bars are placed 24 inches center to center and are provided with glazing caps formed of 18-gauge aluminum secured to the bars with round head aluminum machine screws.

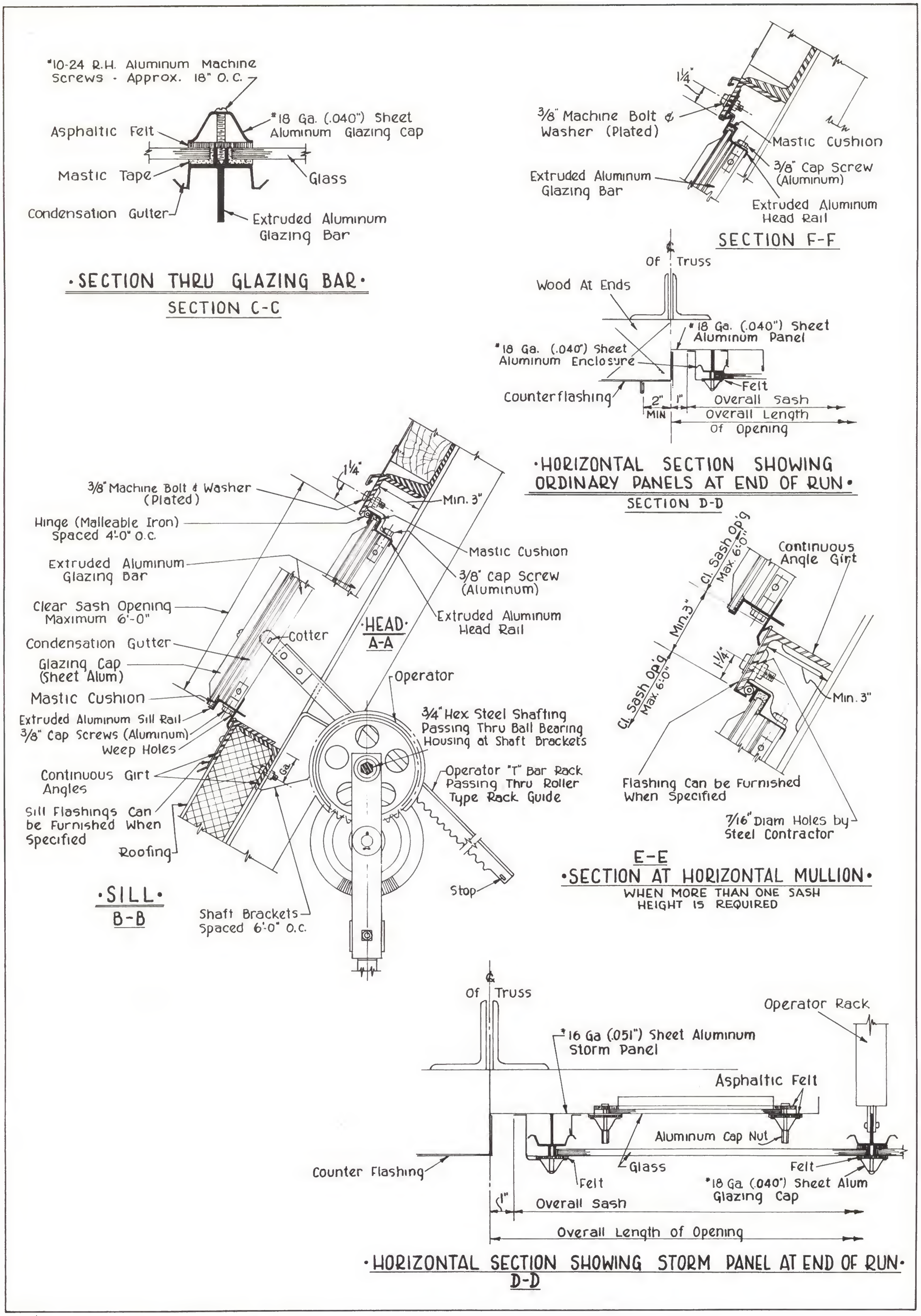
All flashing and panels are formed of sheet aluminum as shown on the details.

The ventilating sections are equipped with rack and pinion type operating mechanism using solid hexagonal steel shafting and roller type pinions. A brass ball race with hardened steel ball bearings in dust tight brass housings are located at 4-ft. centers. Racks are steel Tee sections held in close contact with the pinions by roller guides.

Any standard sash or skylight operator may be used, one for each ventilating section, controlled from the floor with a detachable crank handle. Endless chain control operation is optional.

The glass should be bedded in mastic cushion as shown in the details. The mastic material is protected with a cap secured to the glazing bar with aluminum machine screws. An asphalt impregnated felt strip is applied under the glazing cap.

In general, the limits of the operating sections are: for a sash height of 3 feet—60 linear feet; for a sash height of 4 feet—54 linear feet; for a sash height of 5 feet—50 linear feet; for a sash height of 6 feet—44 linear feet.



Drawing Number 14

ALUMINUM TOP HUNG VENTILATING SASH

Mechanical Operators

While some shops produce mechanical operators for their own operating sash, most shops purchase such operators from concerns specializing in this field or from hardware dealers. There are many systems used to push out or push up vertical or sloping sash and many types of operators or powers.

A few systems and types of powers are indicated in the details shown on preceding pages of movable or ventilating sash.

In general, push arms or rack and pinion devices are used for short runs and where no excessive total weight is involved and tension type operators are used for long runs of continuous top hung sash. Many types of manual operators or powers, controlled by crank or endless chain are available; also motor gear electrical operators.

Vertical Stationary Sash

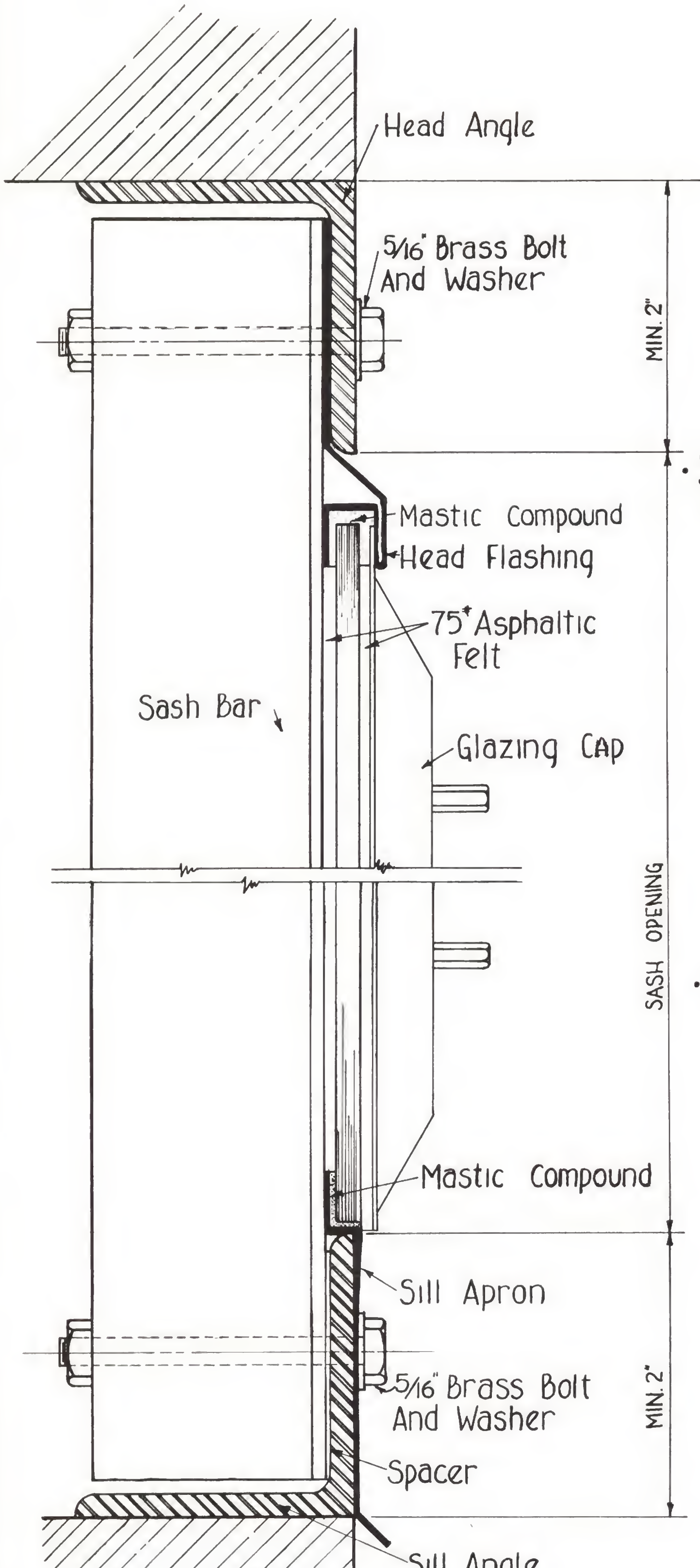
Drawing No. 15

Drawing No. 15 on page 35 shows an interesting use of individual, closed, sheet metal sash bars for vertical, continuous window openings. These individuals glazing bars are particularly useful for continuous or strip lighting. By increasing or decreasing the depth of bar or increasing or decreasing the gauge of metal used, these bars can be used in openings of various heights and with sash bars at various spacings—a very flexible arrangement. The sheet metal parts may be formed of galvanized sheet steel, stainless steel, aluminum or copper—plain or lead covered.

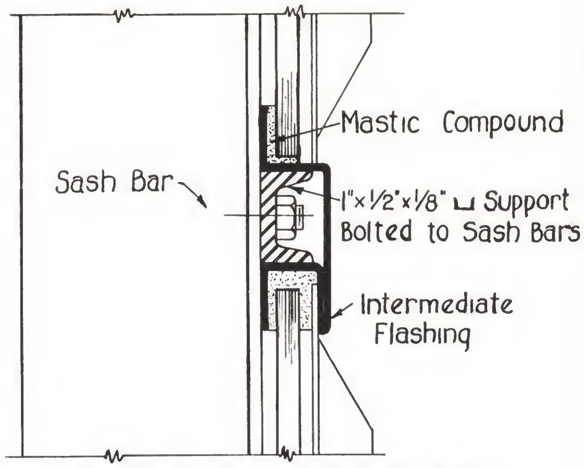
The individual bars are bolted to continuous angles at head and sill and at any spacing desired. Note the simple and practical arrangement of flashing at ends, head and sill.

Note the simple horizontal dividing bar used when two or more runs of glass are required.

The glass is set between two asphalt impregnated felt strips and held securely in place with metal glazing caps. These glazing caps are held firmly to the sash bars with studs and cap units. This type of sash bar is easily adjusted to receive glass of different thicknesses.

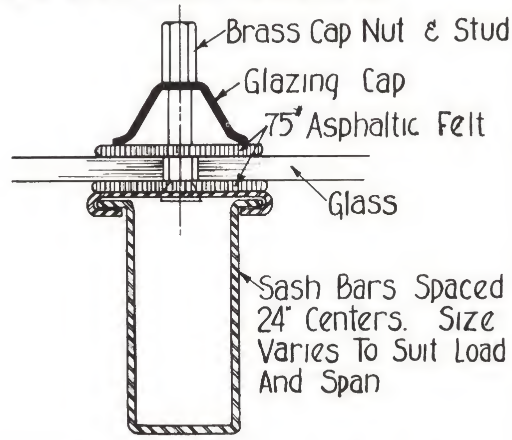


·SECTION THRU SASH·

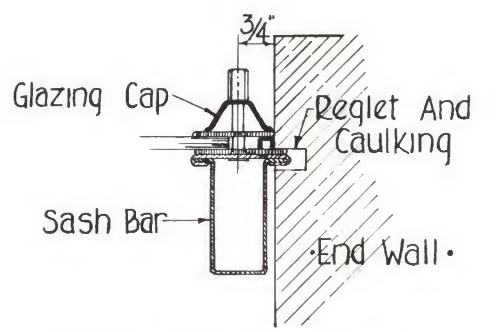


·SECTION THRU INTERMEDIATE BAR·

USED ONLY WHEN GLASS EXCEEDS 82"



·SECTION THRU SASH BAR·



·SECTION AT END·

SASH OPENING	CONSTRUCTION		DEPTH OVERALL	GLASS
	SASH BAR	COVER		
MAX. 6'-10"	#18 GA. GALV.	#18 GA. GALV.	2"	FULL HEIGHT
OVER 6'-10"	#16 GA. GALV.	#18 GA. GALV.	2½"	BUTT JOINT

SHEET METAL TRIM CAN BE FURNISHED IN THE FOLLOWING:

MATERIAL	FLASHING	GLAZING CAP
GALVANIZED IRON	#24 GA.	#18 GA.
ALUMINUM	#20 GA.	#20 GA.
COPPER	20 oz.	20 oz.

DRAWING NUMBER **15**

VERTICAL STATIONARY SASH

Typical Bar Sections — Formed and Extruded

Drawing No. 16

In several of the drawings showing skylight construction, cross sections indicate typical bar construction.

Drawing No. 16 on page 37 shows a group of single glass formed and aluminum extruded bar sections used by manufacturers of skylights.

In addition to the two general classifications—namely, formed sections and extruded sections, there are two other general classifications—namely, puttyless constructions and constructions employing putty for water tightness.

Skylights manufactured by contractors in typical sheet metal shops probably employ a variety of fabricated bar sections. The general types of formed and extruded sections employed by skylight manufacturers are somewhat fewer in number, but too numerous to show in this general treatise on bar construction.

Practically all bar constructions have one feature in common, namely, a method whereby the gasket or putty and the glass and the "glass rest" and bar cap are "squeezed" together to form a weather-proof glazing system.

In Drawing No. 16, Fig. 1 illustrates a manufacturer's skylight bar construction to be used without putty. A "tension" bar with a "supporting bar" which also forms a condensation gutter provide the base section to which is fastened the glass support. When the glass has been placed upon the glass rest, the bar cap is installed as shown and the entire assembly is then drawn up tight by means of the bolt with suitable washers and nuts. This construction is designed to furnish a strong, rigid bar which resists deflection and eliminates any tendency to gyrate under load. Gauges of metals employed are varied to meet the span and other conditions of the skylight dimensions.

Condensation which accumulates in the condensation gutter is passed to the outside through double rows of weep holes suitably positioned around the base framing. With this construction the glass can be removed for installation or cleaning without any special tools. If the bolt shown is made long enough to extend above the bar cap, the bolt with a tubular support provides means for supporting wire guards above the skylight.

Fig 2 shows a construction employing an extruded aluminum base which provides the glass rest and condensation gutter, also a grooved reglet in which the bolt which holds the cap is run. The glass in inserted on top of a mastic filler with an asphaltic felt above the glass. The bar cap is tightened by means of the bolt shown.

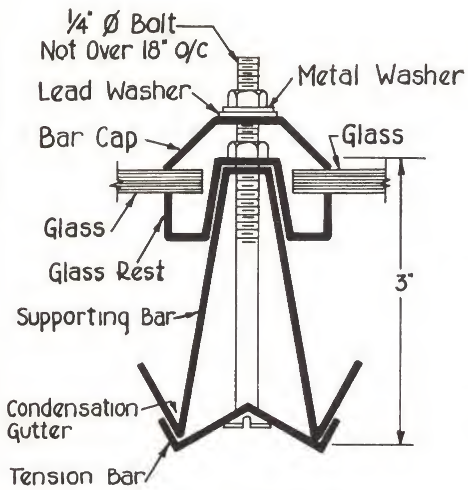
Fig. 3 shows another form of extruded aluminum bar in which a semi-"T" base provides a glass rest wherein the glass is held between two asphaltic felt gaskets. The extruded aluminum cap is tightened down by means of the bolt which is run into a grooved reglet in the base section. This form of extruded bar, with variations in thickness and dimensions, is suitable for practically any span in the skylight.

Fig. 4 shows another variation of the extruded aluminum bar employing a semi-"T" base section which provides a rest for the glass which is supported between two asphaltic felt gaskets. The bar cap is an extruded section. In this particular construction the hold-down bolt has its head held in a slot in the base section with the threads extending above the cap. Tightening is obtained by running a cap down on the threads.

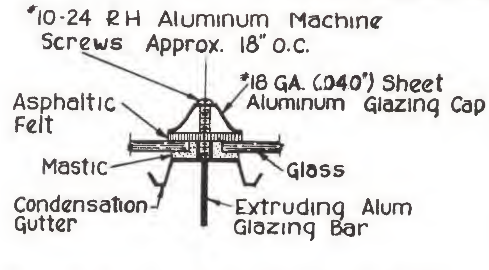
Fig. 5 is a somewhat different extruded aluminum "tubular" construction intended for installations in which the under side of the skylight is exposed. The tubular construction provides a closed, dirt proof appearance which may be desirable in school rooms, offices, etc. The extruded cap and method for tightening and supporting the glass is quite similar to the construction shown in Fig. 3.

Fig. 6 is a comparatively simple formed construction for spans up to six feet in which a U-shaped base provides both glass support and condensation gutter. The U-Section is designed to provide maximum stiffness in the bar base. The glazing bar cap is held in place by a bolt and nut. This construction is intended for the use of putty as shown in the cross section, but asphaltic felt above and below the glass achieves puttyless construction.

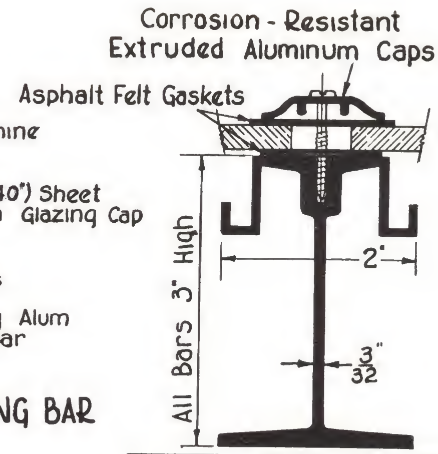
Fig. 7 and Fig. 8 are basically the same as Fig. 6 but an angle or channel is added for additional strength where spans exceed six feet.



BAR SECTION
FIG. 1



SECTION THRU GLAZING BAR
FIG. 2



22 BAR	
WT. 1.2#/FT.	
Sect. Mod.	0.768
20# L.L. Horiz. Span	= 10'-7"
15# L.L. Horiz. Span	= 11'-3"

FIG. 3

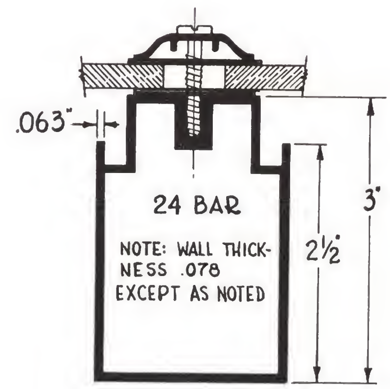


FIG. 5

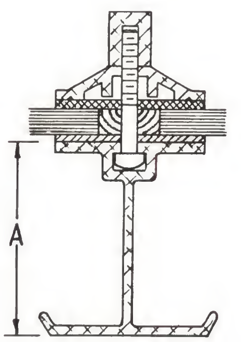


FIG. 4

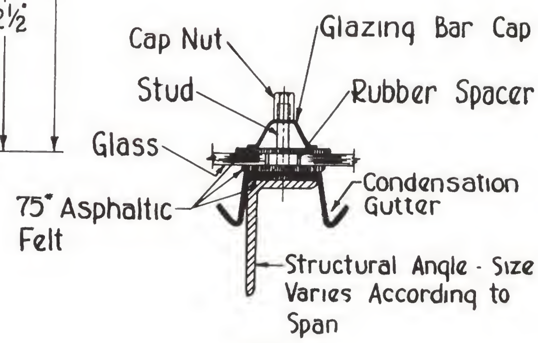
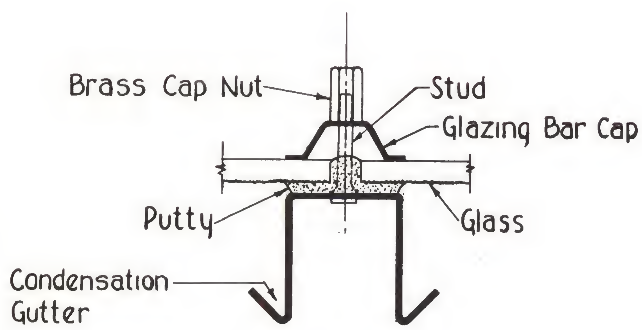
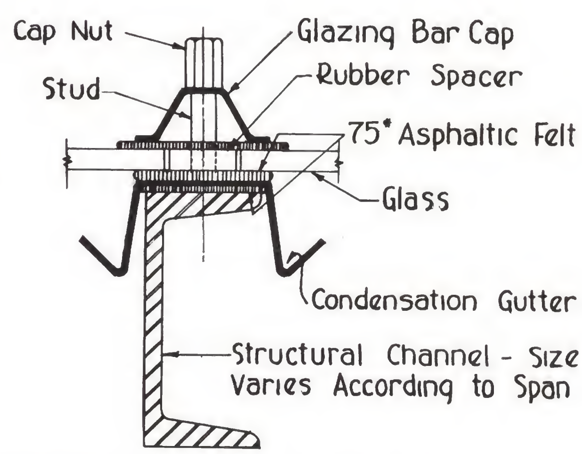


FIG. 7



-SECTION THRU GLAZING BAR-
STANDARD PUTTY CONSTRUCTION
FIG. 6



SECTION THRU GLAZING BAR
FIG. 8

DRAWING NUMBER 16

TYPICAL BAR SECTIONS FORMED AND EXTRUDED

Double Glazing Bars

Drawing No. 17

Double glazing is used to meet air conditioning, temperature, and humidity control requirements in indoor spaces.

Typical constructions for double glazing are shown on Drawing No. 17 on Page 39.

In the usual double glazing construction, the two layers of glass are separated by an air space which reduces thermo change and minimizes condensation on the underside of the interior light of glass.

Double glazing can be used in single pitch, double pitch, turret skylights or in any other skylight construction.

Various metals can be used for the double glazing construction—galvanized iron, aluminum, copper, Monel, stainless steel, etc.

In constructing double glazing bars, the bars usually are spaced at intervals up to 24 inches center to center. Gauges of metals to be used are generally in accordance with standard practice in all types of skylights.

Drawing No. 17 Fig. 1, Section A-A, shows the lower glass tier applied on an asphalt felt gasket, followed by a formed spacer, then the upper tier of glass again laid on an asphalt felt gasket, with a third gasket and the glazing cap applied to finish off the bar. The complete assembly is held to the skylight bar by a suitable sheet metal screw.

Section B-B of Fig. 1, shows the application of the two lights of glass, separated by a continuous insulating filler strip, at the bottom end of the pitched skylight. Section B-B also shows the proper curb flashing and a cross section of the bar cap.

Section C-C shows the construction at the upper end of the skylight, again with the two lights of glass separated with a continuous insulating filler strip, and, in the case of a single pitch skylight, a recommended type of curb flashing with water drip.

A somewhat similar construction is shown in Fig. 2. Section A-A shows the construction of the bar with the lower and upper light tiers supported on formed sections which may be of any suitable material. In Fig. 2 no gaskets are employed. The bar cap and method of assembling the section is similar to Fig. 1.

Details of the ridge and eave sections in Fig. 2 show the method of assembling the two lights of glass. Notice is called in the eave detail of the continuous sheet metal flashing or apron which is made integral with the bar assembly and is continuous from bar to bar.

In the ridge detail this flashing or apron consists of two pieces. The outer apron is continuous across the full width of the skylight and provides weather protection for the top of the curb.

The inner flashing or apron provides the support to which the skylight bar is fastened and in turn provides the method for fastening the skylight to the top of the curb.

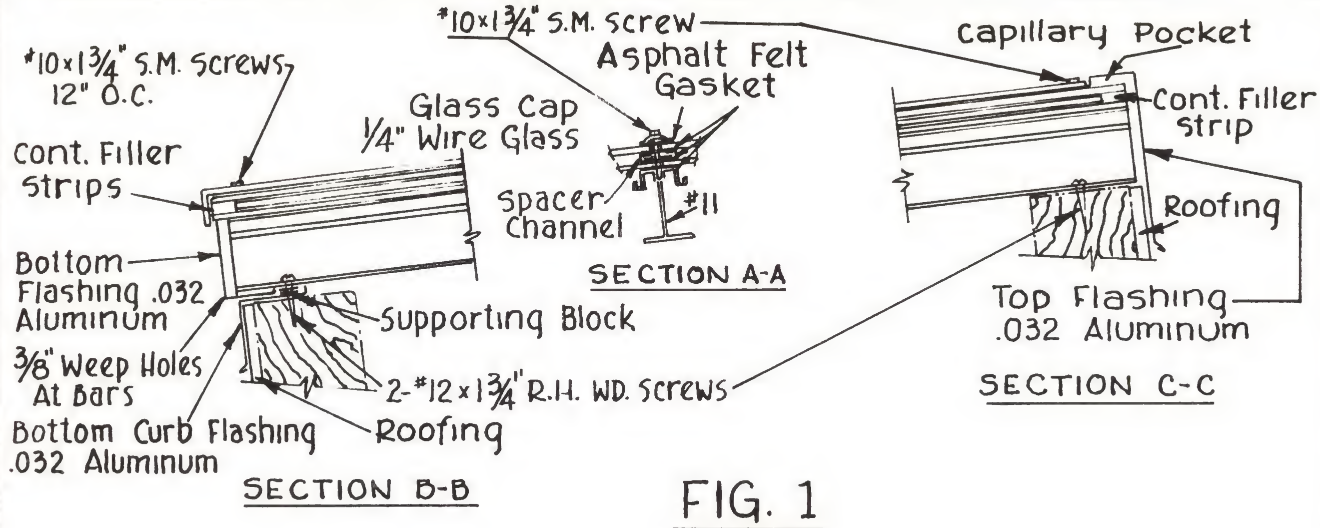


FIG. 1

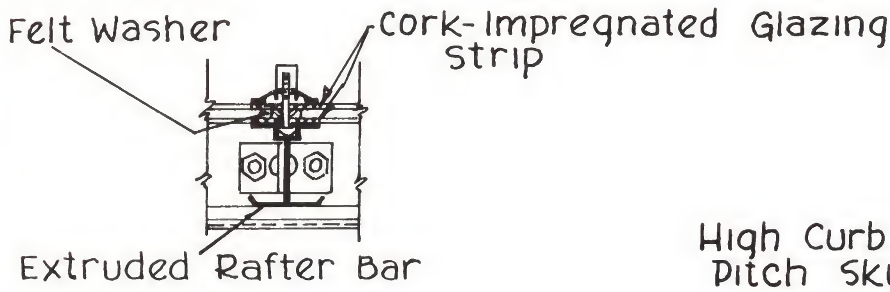


FIG. 3

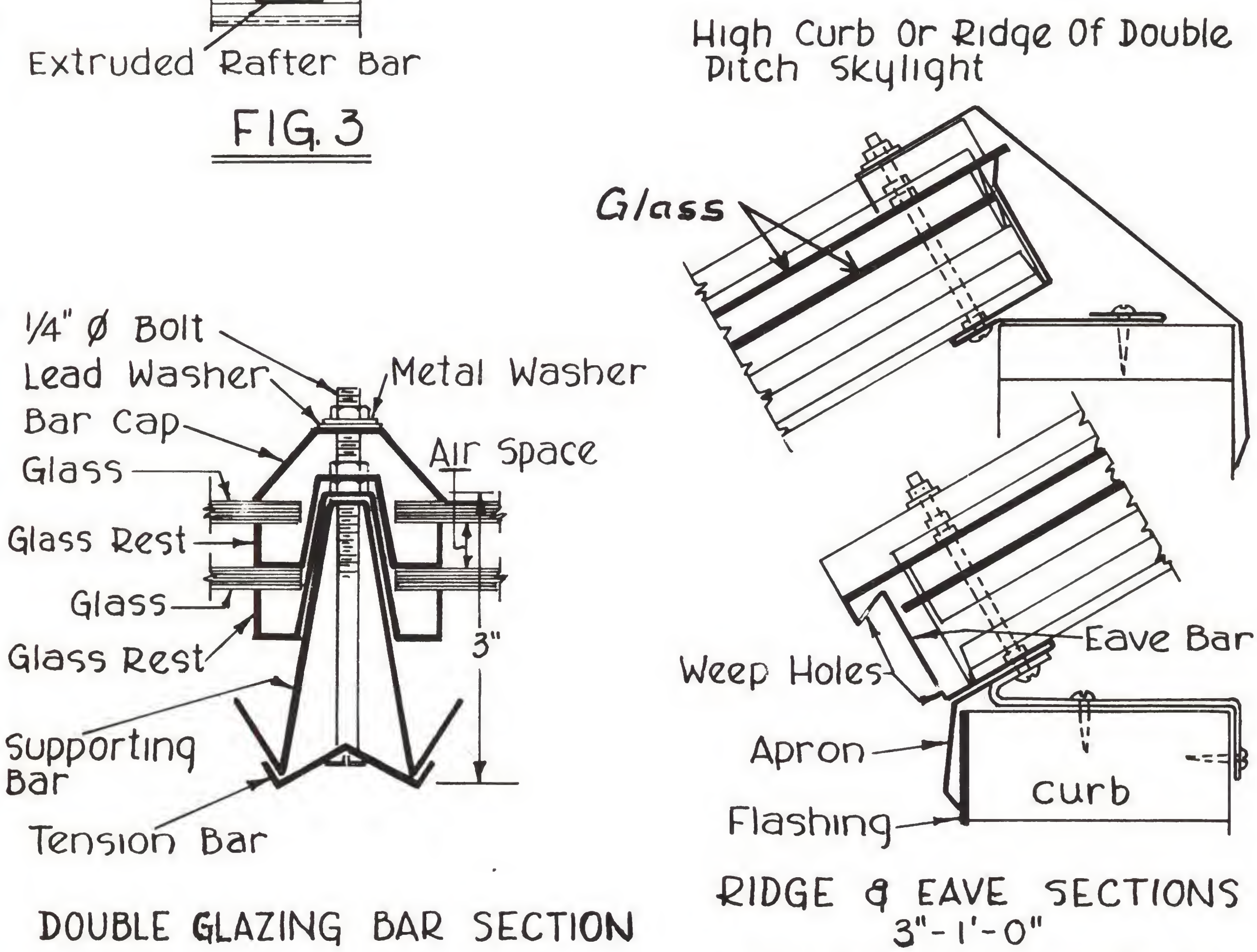


FIG. 2

Plastic Domes

Drawing No. 18

A post-World War II development involves the so-called "plexiglas" type of skylight.

Actually the material used is a thermo plastic acrylic resin material which was developed during the war for turrets in aircraft. The material is shatter resistant, is preformed under heat and pressure from flat sheets of precise thickness to the shape required for the construction. The shape may be rectangular, or circular, or square. Typical examples are shown in Drawing No. 18 Page 41.

The material is light in weight and has a load supporting capacity from four to eighteen times the usual 40 lbs. per sq. ft. loading requirement. The linear expansion of the material is high, approximately four times that of aluminum. Therefore, these domes cannot be fastened down by bolts if cracking of the material is to be avoided. The usual construction accordingly employs "floating" principle without bolts or studs or holes in the dome. The material is suitable for a temperature range from minus 46 deg. F. to plus 160 deg. F.

The usual construction employs a preformed skylight in which the plexiglas is received on the job with a suitable frame. The frame may be of aluminum, galvanized iron, or copper, but is usually of aluminum to save weight. Frames may also be made from extruded aluminum shapes. Self contained condensation gutters are incorporated as shown in the cross section details in Drawing No. 18.

The details in Drawing No. 18 show the application of the framed skylight to a curb preflashed by the sheet metal contractor. Note in the detail the provisions made for expansion and contraction of the plexiglas within the preformed frame.

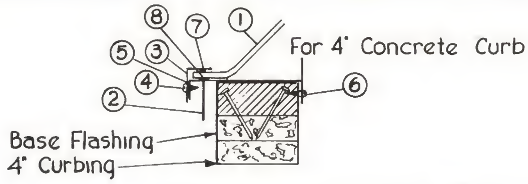
Some construction employs a gasket. Other constructions do not have gaskets, depending for weather tightness on the construction and assembly of the frame.

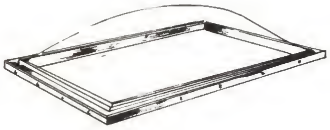
Plexiglas domes are available in white translucent or clear colorless material. The white translucent provides a soft evenly difussed outdoor-daylight, possessing non-glare qualities, with some infra-red rays reflection.

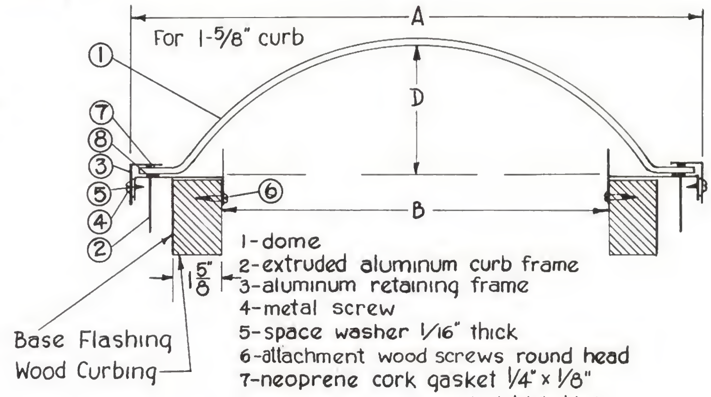
The clear colorless plexiglas most nearly approaches out-door daylight conditions. The clear colorless is said to absorb some ultra-violet rays.

Rectangular plastic domes range in sizes from 20 by 20 to 63 by 100 inches. Circular domes range in sizes up to approximately 60 inches.

The details in Drawing No. 18 show typical constructions of the preformed frame and method of attaching the frame to curbs or openings in the building.

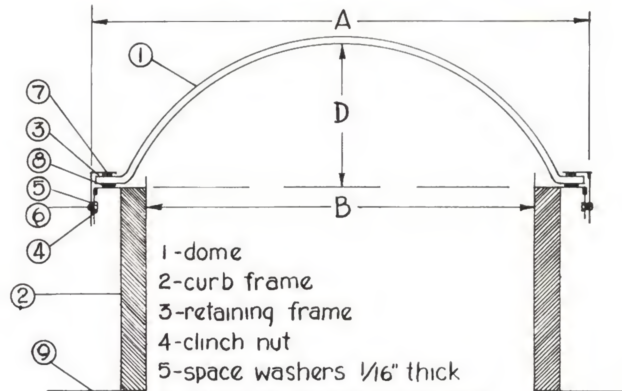






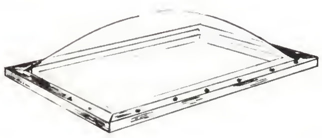
1-dome
2-extruded aluminum curb frame
3-aluminum retaining frame
4-metal screw
5-space washer 1/16" thick
6-attachment wood screws round head
7-neoprene cork gasket 1/4" x 1/8"
8-neoprene cork gasket 1/2" x 1/16"

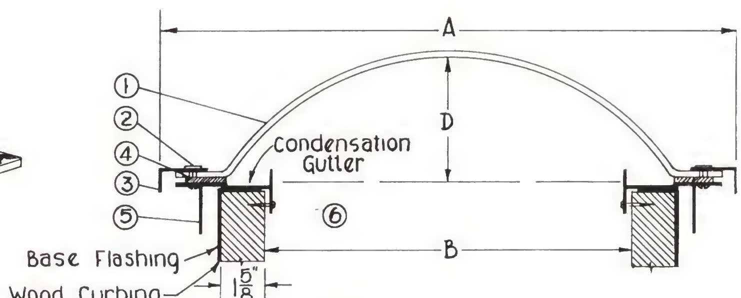
SQUARE AND RECTANGULAR



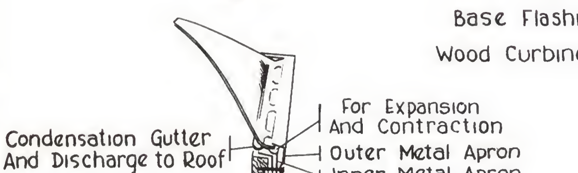
1-dome
2-curb frame
3-retaining frame
4-clinch nut
5-space washers 1/16" thick
6-machine screws truss head
7-neoprene cork gasket 1/4" x 1/8"
8-neoprene cork gasket 1/2" x 1/16"
9-roof flange

CIRCULAR COMPLETE WITH CURB





1-dome
2-frame studs
3-flange frame
4-gasket
5-curb frame
6-attachment screws round head



BLOW-OFF PRESSURE-RELIEF SQUARE AND RECTANGULAR

Top Lights — Roof Lights

Drawing No. 19-20

Drawing No. 19 on Page 43 shows a type of skylight construction employing special glass blocks arranged in prefabricated panels or assembled in properly constructed reinforced concrete grids.

The typical glass block used in this construction measures approximately 10⅝ inches square by approximately 3 inches in thickness. The block is a semi-vacuum type with a fibrous glass mat in the center. These blocks perform a selective function in transmission of light and therefore must be oriented within 30 deg. plus or minus of a north and south axis. The prism structure of the glass block affords efficient transmission and maximum distribution of north light with freedom from glare and solar heat. The construction of the block also provides for increased light transmission during late fall and winter months with a low winter sun. The glass block is also designed to reflect or reject most of the direct light and heat from the sun during hot summer months.

Preassembled or individual blocks may be installed in flat, slanting, curved, square, rectangular or semicylindrical forms when installed in structural framing, the blocks are not bonded directly to the reinforced concrete but are sealed into individual cell openings with a special sealing compound.

Fig. 1 in Drawing No. 19 shows a cross-section within an assembled panel. Note that the edges of the glass block are held in place in preformed extruded aluminum Tee with the space between the block and the Tee filled with a thermofill and capped at the top with a special sealing compound. Fig. 1 also shows the glass fiber mat through the center of the glass block.

Fig. 2 shows a cross-section of a typical panel perimeter bar of extruded aluminum providing the angle to hold the bottom of the block, the space for the thermofill, and a metal nosing under which the roofing felt and cement is placed as shown in Fig. 1 of Drawing No. 19.

Fig. 3 is a longitudinal section showing adjacent blocks and the method of installing material to keep the blocks separated.

Fig. 4 is an erection diagram showing standard factory assembled panels with panel dimensions and number of glass block in each panel.

Fig. 5 is an isometric drawing of a typical corner or perimeter bar, also shown in Fig. 2.

Fig. 6, showing a section at an expansion joint between adjacent factory assembled panels, again shows adjacent perimeter bars and the application of material to provide for expansion and contraction between panels. The material installed at the expansion joint normally will be provided by the roofing contractor.

Drawing No. 20 on Page 44 shows three cross-sections of curbing on which factory assembled top light panels are installed.

Fig. 1 shows a wood curb and cant strip with the roofing felt and cement installed over the cant strip and extending up under the nose in the extruded perimeter bar as shown in Fig. 2 of Drawing No. 20.

Fig. 2 shows a typical concrete curb over which the roofing is applied similiarily to the construction shown in Fig. 1.

Fig. 4 shows typical construction for a steel curb provided by the steel erector and employing a wood cant strip over which the roofing material is applied similarily to Fig. 1.

Fig. 3 shows details of construction for application of glass block in a concrete frame constructed of adjacent grids. This construction is used where standard sizes of factory assembled panels are not suitable.

The construction shown in the top detail of Fig. 3 is repeated as necessary for the size of the opening.

The details also show the method of flashing either with two plys of membrane fabric cemented to concrete surfaces with hot asphalt mopping between plys or suitable metal flashing.

Where this construction is employed, the glass blocks used are semivacuum glass blocks similar to the glass blocks described in Drawing No. 19.

Curbs should be built with approximately ¼ inch pitch in 12 inches in order to provide satisfactory drainage and panels should be installed in strict accordance with the directional markings on the assembled panels.

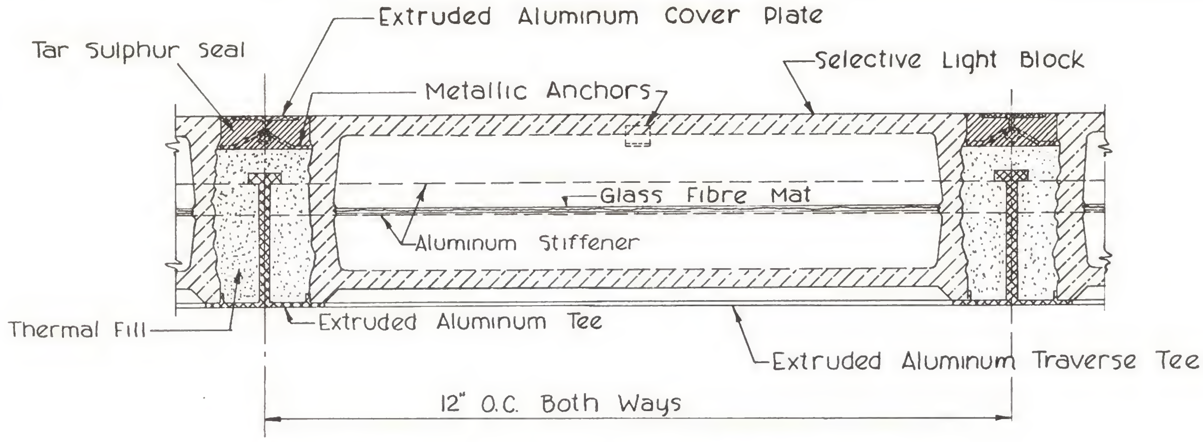


FIG. 1 - SECTION THRU CONSTRUCTION

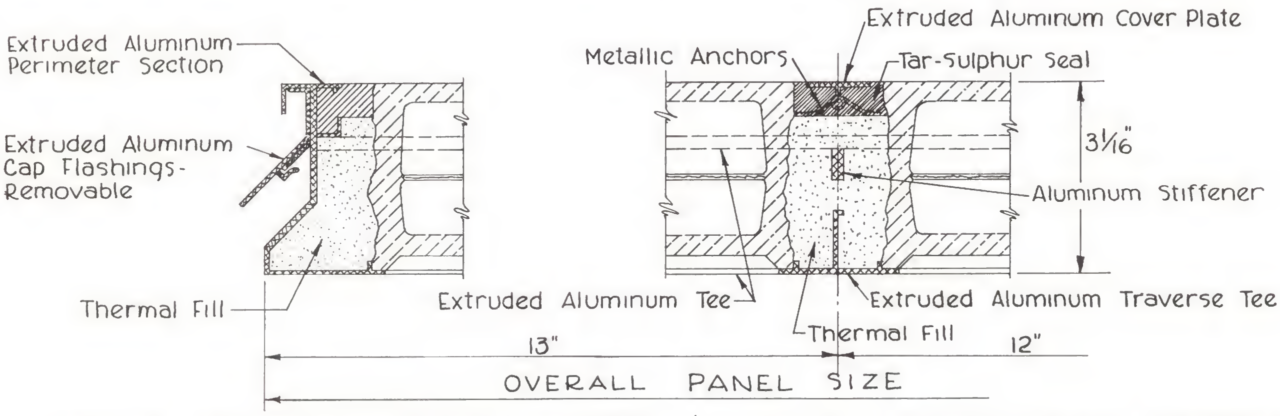


FIG. 2 SECTION THRU OUTER PERIMETER BAR

FIG. 3 - LONGITUDINAL SECTION THRU CONSTRUCTION

STANDARD PANEL SIZES	NO. OF UNITS	PANEL DIM.	STANDARD PANEL SIZES	NO. OF UNITS	PANEL DIM.
NORTH 33NS	3×3	3'-2" x 3'-2"	NORTH 33EW	3×3	3'-2" x 3'-2"
NORTH 44NS	4×4	4'-2" x 4'-2"	NORTH 44EW	4×4	4'-2" x 4'-2"
NORTH 33NS	3×6	3'-2" x 6'-2"	NORTH 63EW	6×3	6'-2" x 3'-2"
NORTH 45NS	4×5	4'-2" x 5'-2"	NORTH 45EW	4×5	4'-2" x 5'-2"
NORTH 54NS	5×4	5'-2" x 4'-2"	NORTH 54EW	5×4	5'-2" x 4'-2"
LEGEND	33 NS = CODE NO. Span Of "T" Bar Shown Thus ←→ ⇧ North-Orientation Of Glass Units				

FIG. 4

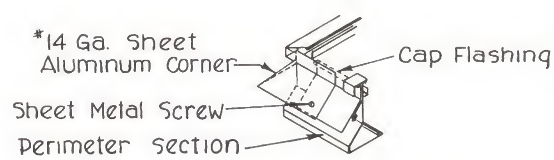


FIG. 5 - ISOMETRIC OF TYPICAL SECTION

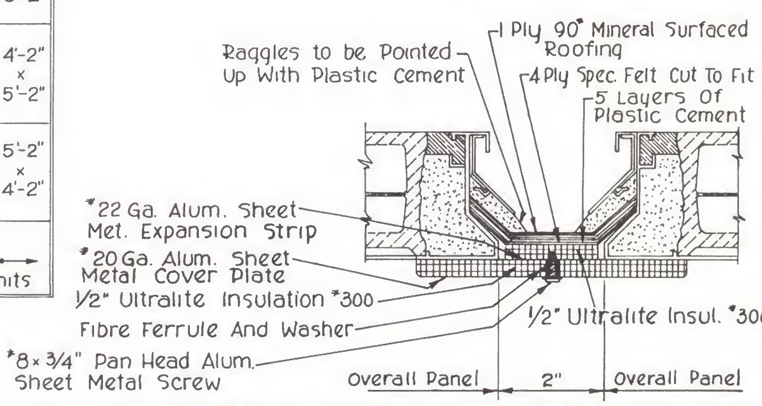


FIG. 6 - SECTION AT EXPANSION JOINT BETWEEN PANELS

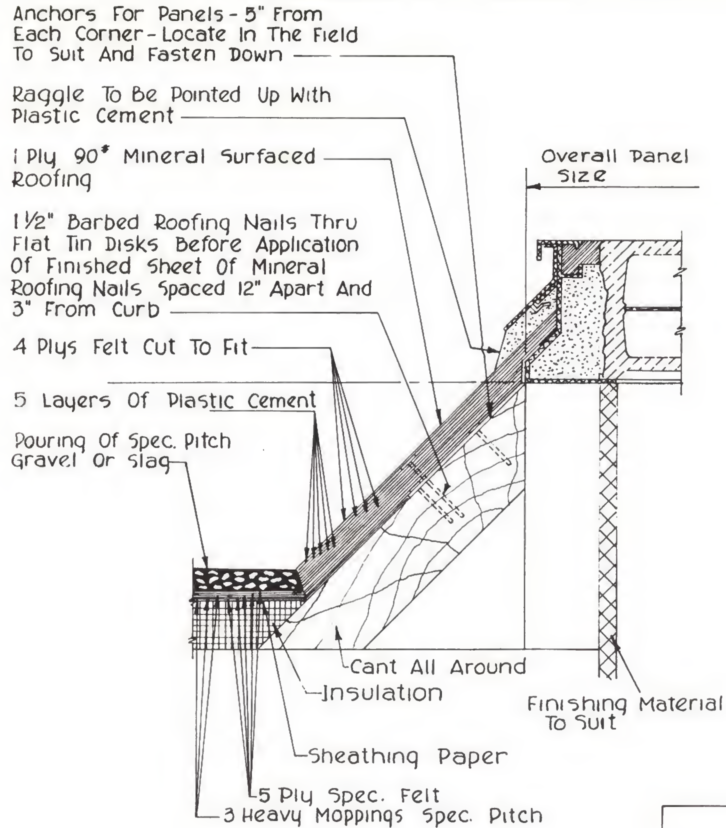


FIG.1-SECTION AT CURBS
TYPICAL WOOD CURBS

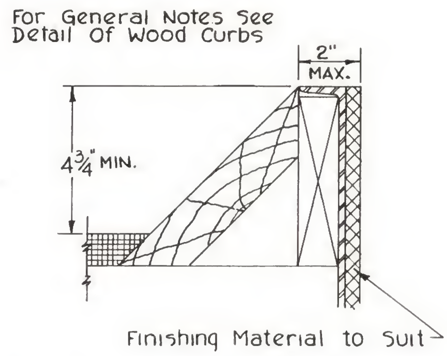


FIG. 3-TYPICAL STEEL CURB

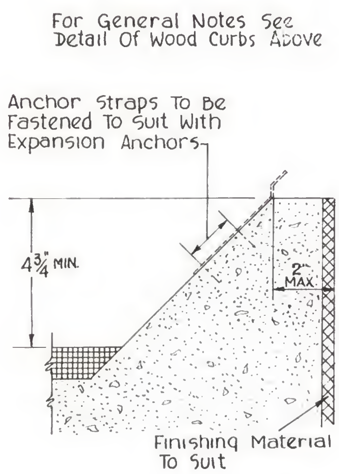
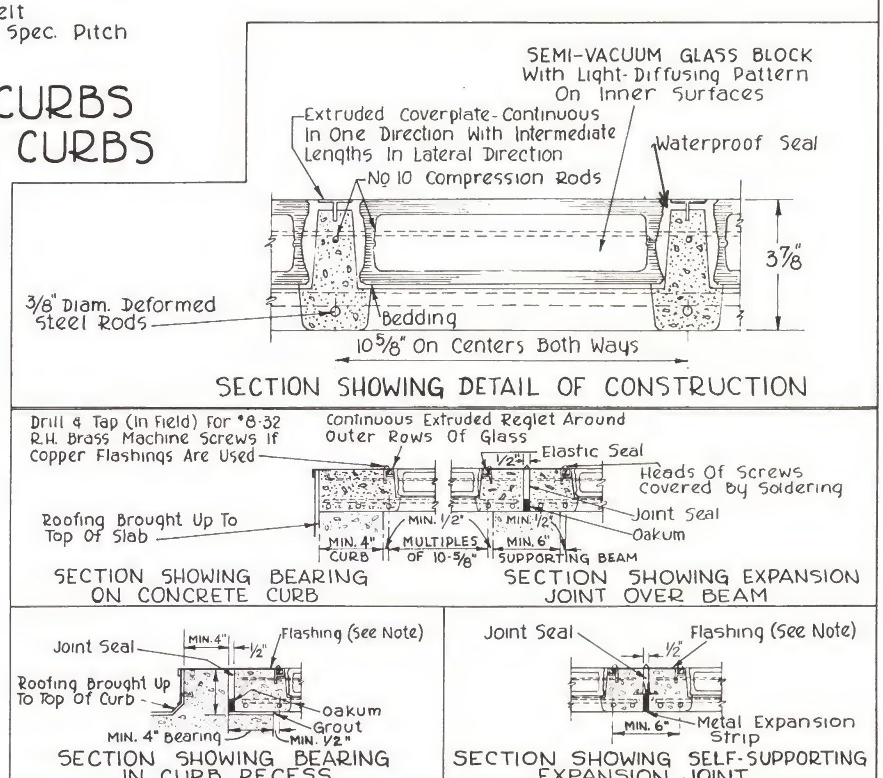


FIG. 2-TYPICAL CONCRETE CURBS



STRUCTURAL DATA

MAXIMUM PANEL SIZES:-
Factory Glazed Panels:
4 Units By 7 Units Or Approx. 28 Sq. Ft Area.
Factory Finished Grids (Glass Set At Job Site)
5 Units By 7 Units Or Approx. 35 Sq. Ft. Area.
MONOLITHIC PANELS (CONSTRUCTED AT JOB SITE)
8 Units By 12 Units Or Approx. 85 Sq. Ft. Site)
MAXIMUM SPAN BETWEEN SUPPORTS:-
Width-Not Over 7'-2"
Length-Unlimited (Using Self-Supporting Joints)
MINIMUM PITCH:-
Provide For Minimum 1/4" To 12" Pitch.
WEIGHT PER. SQ. FT:-
Approx. 35-40 Lbs. (Glazed)
LIVE LOAD:-
40 lbs. Plus Per Sq. Ft.

NOTE: -FLASHINGS-
Flashings Consisting Of 2 Plies Membrane Fabric Cemented To Concrete Surfaces With Hot Asphalt Mopping Between Plies And On Outer Surfaces To Be Furnished And Installed By Roofing Or Sheet Metal Contractor. If Desired, Membrane Flashings May Be Covered With 18 Oz. Lead-Coated Copper As Shown In Details Above.

SCHEDULE OF UNIT MULTIPLES AT 10-5/8" CENTERS			
1 = 0'-10-5/8"	4 = 3'-6 1/2"	7 = 6'-2 3/8"	10 = 8'-10 1/4"
2 = 1'-9-1/4"	5 = 4'-5 1/8"	8 = 7'-1"	11 = 9'-8 7/8"
3 = 2'-7-7/8"	6 = 5'-3 3/4"	9 = 7'-11 5/8"	12 = 10'-7 1/2"

FIG.4-STRUCTURAL DETAILS AND DATA
TOP LIGHTS

Glass for Skylights

The traditional material employed for skylights is glass, which, over the years, has afforded proven performance and the chemical stability, permanence of finish, color, shape, surface hardness, non-inflammability, and the other characteristics which are required or desired in a skylight.

Glass employed for skylight construction may be rolled, figured, plain wired or hammered wired glass with additional variations of the glass construction and finish.

Most patterns of rolled glass can be obtained with either a fire polished surface or one which is acid etched. The etched surface serves to give greater diffusion of the light coming through the glass and thus furnish a greater spread of even illumination throughout the interiors. This finish is permanent, is not affected by time and weather and will never have to be renewed.

Important in skylight construction is the light transmission characteristic of the glass or material employed. Often times the problem with skylight installation is to provide as much light as possible at some distance from the glass surface of the skylight. To accomplish such uniformity of lighting, some diffusion must be employed to throw a portion of the available light some distance from the skylight. There are different types of diffusing glass, some employing "directional diffusing" for still longer throw of the entering light.

Another problem in skylight glass construction is to reduce the glare resulting from light entering the skylight. To accomplish glare reduction, the use of newly developed translucent glass is commonly employed. There are numerous types of glass intended for light diffusion. The skylight contractor, advised of the diffusion requirements, can recommend a proper type of glass for the skylight.

Another desirable characteristic is heat absorption. The admission of maximum natural daylight, coupled with the interception of solar heat to keep interiors more comfortable, is a characteristic desirable for skylight construction. Different types of glass have different heat absorption rates. Where heat absorption is an important feature, the glass selected should approximate 80% of solar heat interception by reflection and absorption and 20% solar heat passing through the glass without interference. Theoretically, the energy so absorbed raises the temperature of the glass which then re-radiates heat equally from both the inner and outer surfaces, but in actual installation probably more than half of this heat is dissipated outside of the building because of greater air circulation outdoors.

Constant fire protection, together with maximum daylight illumination, is commonly met by the skylight installer with the use of wired glass as approved by Underwriters Laboratory standards.

There are several types of wire employed in glass construction, some forms being diamond shaped, others hexagonal netting, still others square or rectangular.

To meet fire protection requirements, the wire glass must have approval as fire retardant No. 32 given by Underwriters Laboratories. To obtain this approval the temperature of the glass is raised to approximately 1600 deg. F. in forty-five minutes and is held at this point for an additional fifteen minutes. At the end of the fifteen-minute period the glass is subjected to a three-quarter inch stream from a fire hose applied at thirty-five to forty pounds of pressure. To pass the test the glass must remain in the sash and remain substantially unchanged except for such cracking as is due to thermo-shock.

Plastics for Skylights

In recent years a new type of material has appeared and is being employed for practically all types of skylight construction.

Commonly termed "plastics" the chemical composition of these materials varies somewhat, but in general these "plastics" offer shatter-proof, translucence, coupled with light weight, high strength, weather resistance.

The different resins employed may be reinforced with fibrous glass. Some plastics might be termed glass reinforced polyester resins similar to the materials now being used for boat hulls and air craft parts. Most of these plastic materials possess installation characteristics such as cutting of the sheet with an abrasive wheel or a fine-tooth hand saw, or a hack saw, or a metal cutting saw. Where the material is not placed in skylight framing, the plastic sheets may be nailed following the recommended procedure of drilling holes for the nails. Weather tightness is obtained by employing a large lead nail head or sheet metal screws with a similar lead washer.

Some additional characteristics of these plastic materials are tensile strengths in the neighborhood of 10,000 lbs. per sq. in. with flexural strengths of approximately 20,000 lbs. per sq. in. Light transmission varies according to color and glare reduction finish specified, but a visual light transmission up to 90% under Federal Specification 3021 is obtainable. In heat transmission, some forms show a thermo conductivity of approximately 1.7 Btu per hour, per sq. ft. per degree F., per in. or approximately a heat transmission equaling 40% of the heat transmission of plain glass. Thermo stability ranges between 65 deg. below zero and 212 deg. above zero. The coefficient of expansion approximates aluminum or .000014 in., per in., per degree F. temperature change. Impact, fire, and chemical resistance of this plastic material is within most specifications for skylight construction.

These plastic materials may be obtained in several widths and lengths and as either flat, standard curved, or special curved sections.

When employed in skylights a special translucent type of water proofing mastic is recommended.

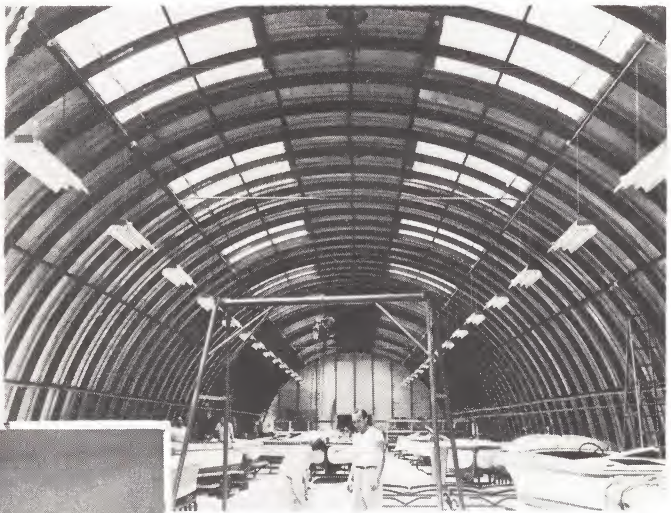
Some of these plastic materials possess sound absorption characteristics obtained by the combination of a glass mat incorporated in the thermosetting resin component.

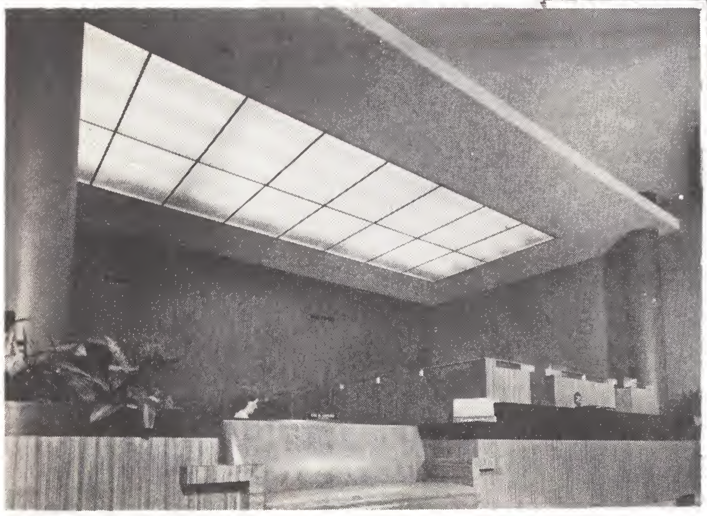
An interesting characteristic of some plastics used for skylight construction is indicated by tests where burning embers were placed on the exterior surface of the plastic material, or fire was directed against the inside surface of the plastic material. In both of these tests the surface adjacent to the ember or fire ignited at temperatures of approximately 835 deg. F. but the opposite plastic surface did not ignite indicating that the glass mat incorporated in the plastic sheet acted as a heat transmission barrier.

Photos on Page 47 show three typical installations of plastic materials for skylights. In the upper photograph corrugated plastic is used without any special framing and is installed as sheets among the corrugated iron sheets of the roof.

In the midde illustration a similar corrugated plastic sheet is employed as a row of lights and in this case the plastic material is furnished with the same contour as the galvanized iron for the building proper.

In the lower illustration plastic installed in framing as a "Top Light" (see Chapter on Top Lights) provide specified daylight through the use of specified light diffusion or colored plastic materials. The light weight of the material minimizes the need for substantial or intricate supporting framing.





PLASTICS FOR SKYLIGHTS

Various Types of Sheet Metal Skylights

***Drawing No.* 21**

Drawing No. 21 shows twelve types of sheet metal skylights, including flat, single and double pitch, hipped with ventilators, louvres and operating sash.

Fig. 1 shows a single pitch skylight for a flat roof, the pitch being made in the sheet metal curb with closed metal ends. The flat skylight for a pitched roof, indicated in Fig. 2, may be constructed to open and close the full area of the skylight opening by means of an operating device. In constructing a skylight of this kind, care must be taken to have a saddle above the skylight indicated by *A*, to shed water on either side, otherwise dirt will collect, which will hold moisture and eventually corrode the metal flashing. Fig. 3 shows a theatre stage skylight of the "rolling type" which operates on brass rollers, the skylight being quickly released in case of fire by the use of fusible links. The other type, known as the "counter-balanced sash," is described in detail in this section. Fig. 4 shows one section of a saw tooth or north light skylight. In this type the roof and sides of the saw tooth are covered with metal, and if desired, the sash in this skylight can be made to open for ventilation.

A plain, double pitch skylight with closed metal ends, is presented in Fig. 5. Fig. 6 is a similar skylight with a tubular ventilator at each end. If desired these ventilators can also be placed on the ridge of the skylight. Fig. 7 shows a similar skylight with either stationary or movable louvres placed in each end. Fig 8 is a plain hipped skylight, Fig. 9 a similar skylight with tubular ventilators placed along the ridge and Fig. 10 is also a hipped skylight with a ridge ventilator placed along the full length of the ridge.

Fig. 11 shows stationary or movable sash set under a hipped skylight. These sash may be made any height and are manipulated by means of operators from the floor below. A similar hipped skylight is shown in Fig. 12 with stationary or movable louvres and are operated like the sash just described. All of the types shown here are detailed in this section.

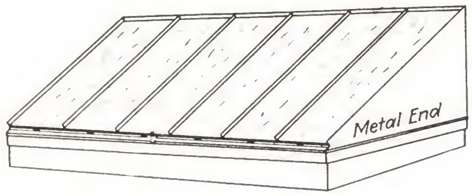


FIG. 1 *SINGLE PITCH SKYLIGHT*

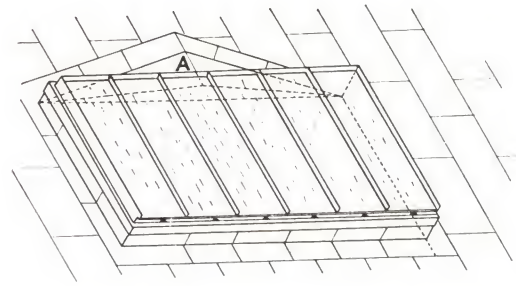


FIG. 2 *FLAT SKYLIGHT ON PITCHED ROOF*

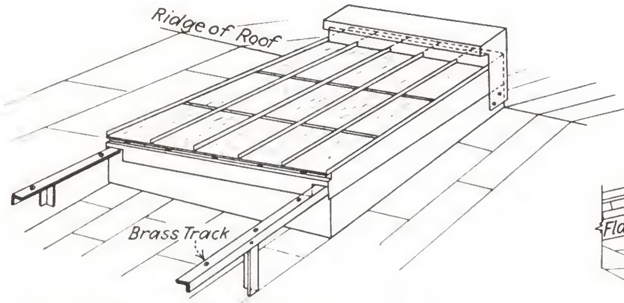


FIG. 3 *THEATRE STAGE SKYLIGHT OF THE ROLLING TYPE*

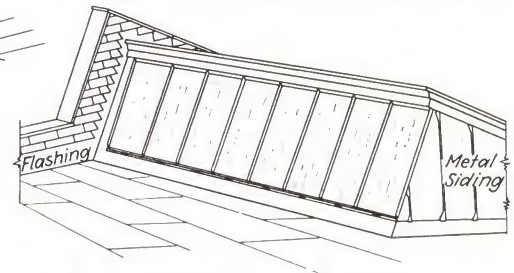


FIG. 4 *PARTIAL VIEW OF SAWTOOTH OR NORTH LIGHT SKYLIGHT*

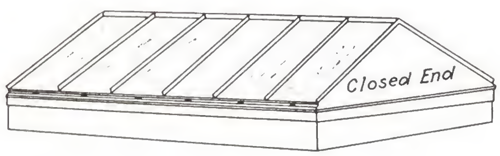


FIG. 5 *DOUBLE PITCH SKYLIGHT*

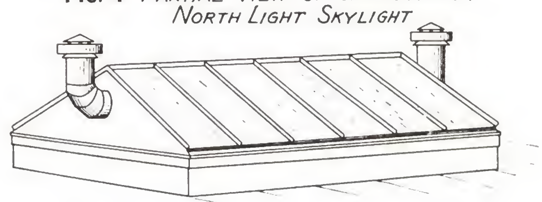


FIG. 6 *DOUBLE PITCH SKYLIGHT WITH TUBULAR VENTILATORS AT ENDS*

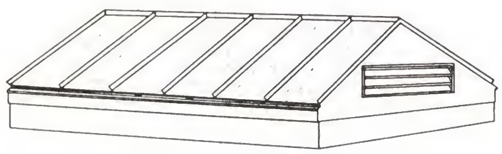


FIG. 7 *DOUBLE PITCH SKYLIGHT WITH STATIONARY OR MOVABLE LOUVRES AT ENDS*

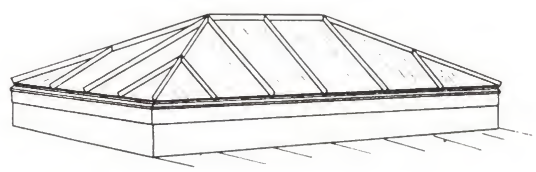


FIG. 8 *PLAIN HIPPED SKYLIGHT*

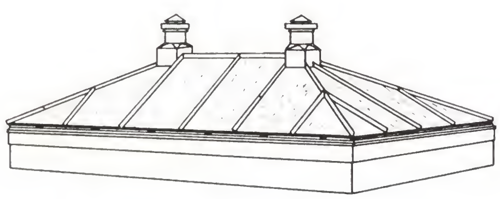


FIG. 9 *HIPPED SKYLIGHT WITH TUBULAR VENTILATORS*

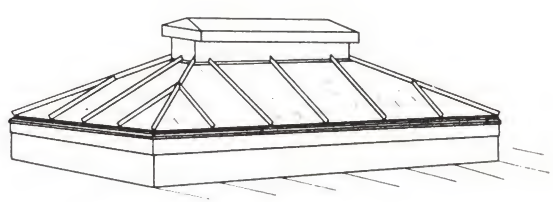


FIG. 10 *HIPPED SKYLIGHT WITH RIDGE VENTILATOR*

FIG. 11 *STATIONARY OR MOVABLE SASH UNDER HIPPED SKYLIGHT*

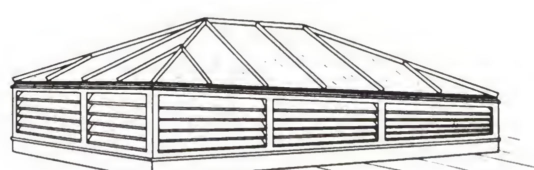


FIG. 12 *STATIONARY OR MOVABLE LOUVRES UNDER HIPPED SKYLIGHT*

Part 2—Ventilators

Part 1 of this Manual dealt with the design and installation of weatherproof skylights to admit light into interior spaces—this Part 2 deals with the design and installation of weather-proof apparatus to exhaust heat, smoke, fumes from interior spaces.

Ventilators—as a general term covering all forms of apparatus—may be divided into two classifications: (1) the so-called "stack" type of which there are two sub-divisions (a) gravity type and (b) power type employing a fan for positive exhaust and (2) the "continuous" type which normally is located along the ridge of the building.

The selection of the ventilator type depends on several factors. The quantity of air to be exhausted is perhaps of first importance since quantity determines the type, size, number of units required.

For gravity exhaust, a "stack" type unit will, in general, function if there is—a temperature difference; a reasonable stack height; an adequate intake area. Two other points should be considered; heavier-than-air fumes cannot be moved by gravity flow; there should not be other power exhaust working in the same space.

For gravity exhaust—where the quantity of air to be exhausted calls for numerous stack ventilators and where the structure provides a "high point" for the ventilating unit—the continuous type ventilator may be preferred to many stack units.

Where the quantity of air to be exhausted or the fumes are heavier than air or exhaust must be positive regardless of interior or exterior conditions, the power type ventilator is indicated.

Design of both gravity and power types of ventilators is infinite. Likewise, the "ratings" applied to air moving capacities, are beyond the scope of this Manual and should, accordingly, be determined in consultation with the contractor or manufacturer.

Gravity Ventilators

Drawing No. 22

Drawing No. 22 on Page 51 shows a group of gravity, roof-type ventilators.

Information on gravity roof ventilator characteristics and operating efficiencies, under specified weather conditions, is described in greater detail in the reprint of a government bulletin describing tests of gravity roof ventilators.

Fig. 1 in Drawing No. 22 illustrates a "storm band" type of ventilator incorporating within the storm band a weather cap, diffuser plate, and supporting frame work.

Fig. 2 is a typical "turbine" type with internally braced ventilators. Some turbine ventilators are internally supported, others have external supports for the rotary member.

Fig. 3 illustrates the directional-type" ventilator which revolves according to wind direction, thus presenting a closed back to the wind direction. The revolving, supporting, frame work operates on suitable bearing surfaces.

Fig. 4 illustrates another type of storm band ventilator with an inside baffle at both top and bottom. A screen is employed to keep out birds.

Fig. 5 illustrates a type of ventilator having three exhaust areas, totaling approximately three times the stack area, a cap and louvre ring for weather tightness, and suction areas across the top and bottom.

Fig. 6 illustrates a "siphon" type of gravity ventilator with V-shaped openings at the top above the cylindrical outlet pipe, two hoods for weather tightness, and four "siphons" below the storm band.

Fig. 7 is another type of storm band ventilator with siphons, a top storm band, a second band enclosing the top opening of the siphon. A screen is employed to keep out birds.

Fig. 8 is a low type base and neck with a circular, multiple blade louvre damper built into the neck.

Fig. 9 shows four types of commonly used "square to round" bases for gravity roof ventilators. Bases are provided for a flat roof, for a single pitch roof, for installation at the ridge with double pitch, and for installation on wood, concrete or steel curbs. Dimensions vary according to the size of ventilator to be installed and the desired height of the ventilator above the roof.

Fig. 10 illustrates two standard types of dampers available for gravity roof ventilators. The butterfly type consists of two leaves with a center bearing and operating mechanism for either manual or motor operation. The flat type damper is normally hinged in the center and is balanced by a weight which keeps the damper open until the damper is closed by the operating chain.

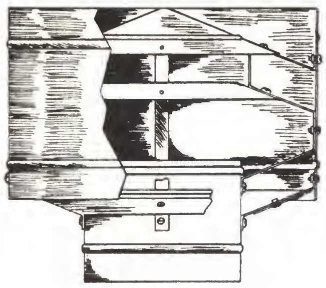


FIG. 1

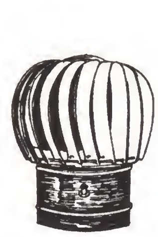


FIG 2

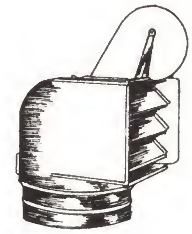


FIG. 3

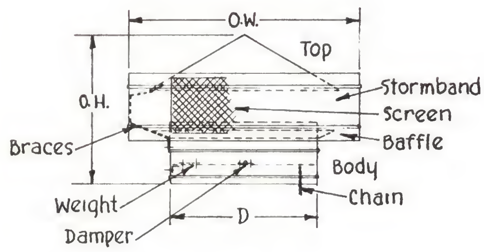


FIG. 4

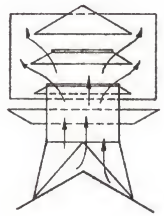


FIG. 5

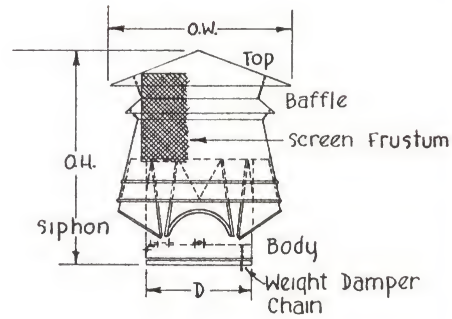


FIG. 6

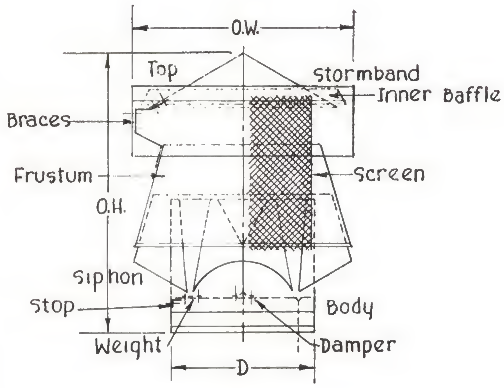


FIG. 7

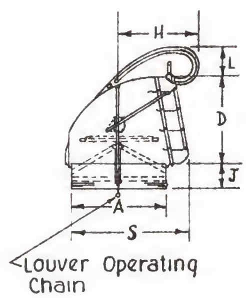


FIG. 11

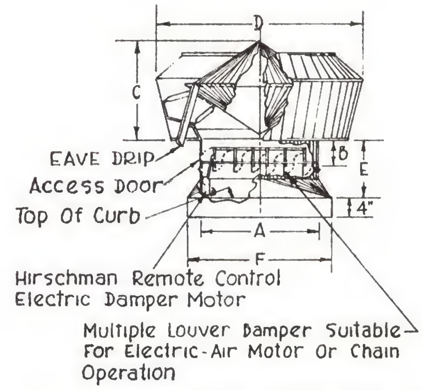
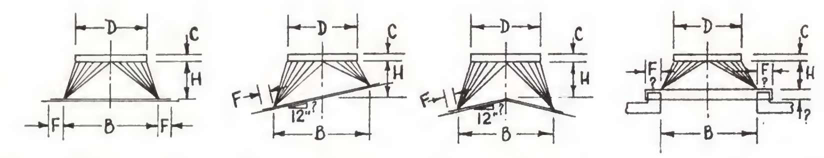


DIAGRAM OF L-U VENTILATOR

FIG. 8



SQUARE TO ROUND BASE FOR FLAT ROOF.

SQUARE TO ROUND BASE FOR SIDE OF ROOF. INDICATE ROOF PITCH.

SQUARE TO ROUND BASE FOR RIDGE OF ROOF. INDICATE ROOF PITCH.

SQUARE TO ROUND BASE FOR WOOD, CONCRETE, OR STEEL CURB. INDICATE HEIGHT AND WIDTH OF CURB.

FIG. 9

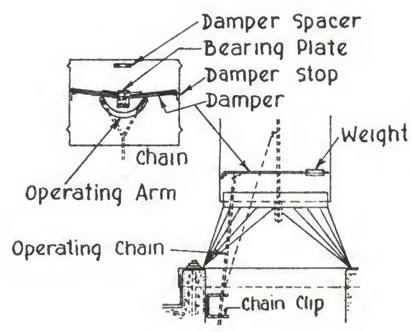


FIG. 10

Some Comparative Tests of Sixteen-Inch Roof Ventilators*

By H. L. Dryden, W. F. Stutz, and R. H. Heald,[1]
Washington, D. C.

Drawing No. 23

During the summer of 1920 a study of some fifty 16-in. ventilators, shown in Drawing No. 23, was made at the Bureau of Standards, the ventilators having been submitted by the Construction Division, Q. M. Corps, of the Army. The following paper gives a brief summary of some of the results of the study.

The factors affecting the performance of a ventilator and the things which must be taken into consideration in the choice of a ventilator are so numerous that it was impossible to attempt a complete study. We limited ourselves definitely to certain specific phases of the problem and it must be kept in mind that the tests about to be described are particular tests with a certain experimental arrangement. The question as to how far the results of these tests apply to any other arrangement is left open.

Our experiments were confined to questions concerning the volume of air exhausted per minute by the ventilators, which is dependent upon many factors. For example, if the air does not have free access to the room, little air will be exhausted. If there are obstructions near the ventilator, the performance will be affected. The most important factors, however, affecting the performance of a ventilator are (1) the difference in temperature between the air in the room and the air outside and (2) the speed of the wind blowing across the top of the ventilator. Our experiments were restricted to these two factors.

The effect of a temperature difference is to produce the familiar chimney action, an action common to all ventilators, including an open pipe. The design of the ventilator affects the amount of air exhausted under a given temperature difference only insofar as more or less resistance is offered to the flow of air. If the ventilator passage is obstructed, less air will be exhausted. From this standpoint, a straight open vertical pipe is the ideal ventilator, but considerations of weatherproofness prohibit its use.

The exhaust due to the wind depends primarily upon the design of the ventilator. Our first experiments were arranged so that the temperature at the entrance and exhaust were the same, so that there was no chimney action. The exhaust for various wind velocities was measured with the set-up in which the wind was produced by one of the wind tunnels of the Bureau of Standards. For the purpose of these tests the exhaust fan of the tunnel was removed and a blower fan substituted. By means of suitable honey-combs the velocity was made as nearly uniform as possible across the stream. The ventilators were placed in front of the mouth of the tunnel on the end of a vertical pipe, the wind stream being horizontal. A horizontal pipe containing the measuring apparatus was joined to this vertical pipe by means of an elbow.

The speed of the wind was obtained from the readings of a tachometer connected to the shaft of the wind tunnel motor, the readings of the tachometer having been previously standardized in terms of an anemometer placed in the position later occupied by the ventilators.

The volume of air exhausted was obtained from the deflections of a small wire suspended freely in the horizontal pipe from a watch-bearing mounting. The wire anemometer was calibrated by comparison with an orifice meter.

Measurements were made of the volume of air exhausted per minute by the ventilators at wind speeds of 4, 8 and 12 miles per hour. For comparison, index numbers or wind ratings were obtained by expressing the volume exhausted by a ventilator as a percentage of the volume exhausted through the open pipe in the same time at the same wind speed. The wind rating of the open pipe is therefore 100 at all wind speeds. The accuracy of the measurements is about 5 per cent, and smaller differences in ratings are of no sig-

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[1]—U.S. Bureau of Standards, Washington, D.C.

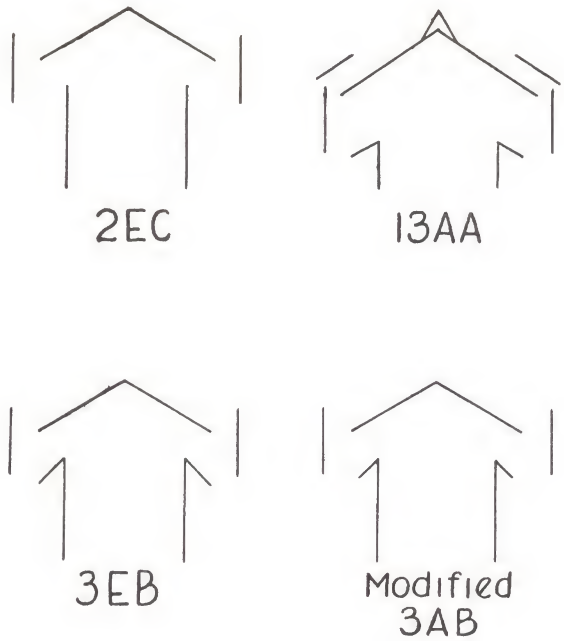


Fig. 3

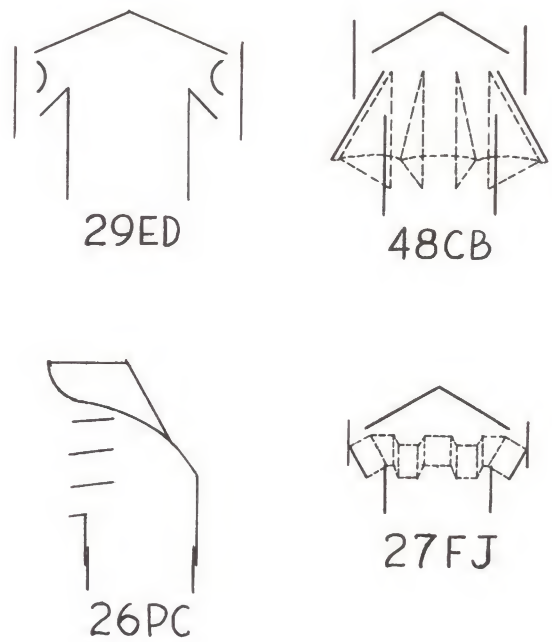


Fig. 5

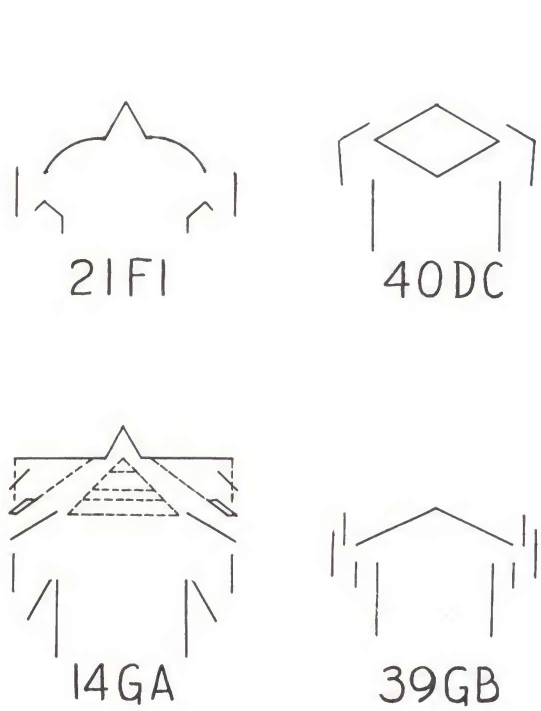


Fig. 4

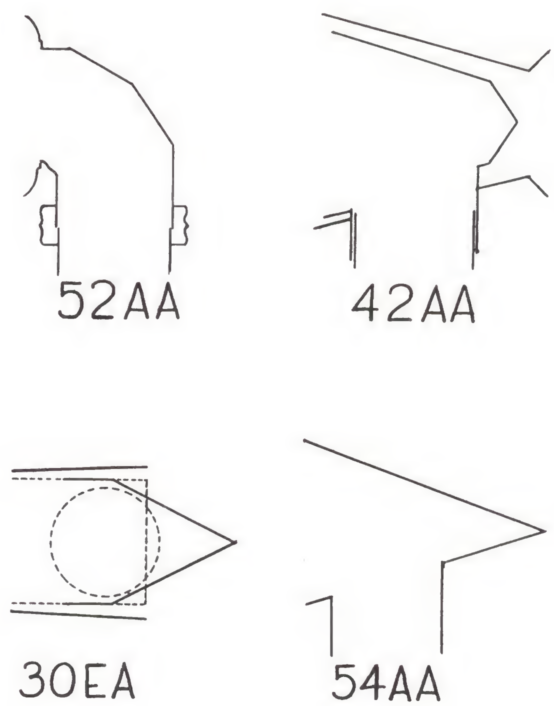


Fig. 6

nificance. Some ventilators exhaust less air than an open pipe, some more; the best ventilators have a rating of 150, the exhaust being one and one-half times as much as from an open pipe. The exhaust of an open pipe with the set-up used was about 230 cu. ft. per minute for a wind speed of 10 miles per hour.

In addition to the measurements of the volume of air exhausted at varying wind speeds with no temperature difference, measurements were made of the flow of air through the ventilators with a given difference in pressure in order to simulate the effect of a difference in temperature between the air of a room and the air outside. An electric fan was placed at the entrance of the ventilator pipe line and the volume of air per minute passing through the pipe was measured at various speeds of the fan. It is evident that if the fan is running at a uniform speed and the same flow is obtained with two different ventilators, the resistance of the two ventilators are equal and consequently under a given temperature difference the same volume of air per minute would be exhausted by the two ventilators. If the flow through one ventilator is less, its resistance is greater and it would exhaust less air under the same temperature difference. Ratings were again made on the basis of the open pipe as 100. In these resistance ratings, 100 is the maximum attainable, since the resistance of the ventilator is added to that of the pipe.

Ventilators may readily be divided into those of stationary and rotary forms, but any further sub-division for purposes of discussion is difficult. The simplest type of ventilator consists of a cap over the top of an open pipe with a band around pipe and cap to keep the rain from beating in. Such a ventilator exhausted 94 per cent as much air as an open pipe at the same wind velocity. In other words, it has a wind rating of 94. It permitted 86 per cent as much air to pass as an open pipe in the second experiment. This will be expressed by saying that the **resistance** rating is 86.

A simple modification of No. 2 is shown in ventilator No. 3 where a lip is placed on the pipe. This ventilator is very sensitive as regards its orientation relative to the wind. On introducing a smoke stream it was found that the air passing under the band separates into two parts, one part passing under the cap and diagonally out at the sides of the ventilator, the other passing underneath the lip and around the pipe. The quantity of air going by the two routes depends on the orientation of the ventilator relative to the air stream. The results varied by about 10 per cent in different experiments, according to the orientation. This ventilator had a wind rating of 96 and a resistance rating of 88.

To investigate more fully the effect of the band, the band was lengthened as shown in modified No. 3 so as to extend a little below the lip. The wind rating increased from 96 to 130 and on an examination with a smoke stream it was found that no air entered the ventilator at all. The air blowing on the ventilator passes underneath the lip, the ventilator exhausting all the way around. Ventilator No. 13, of somewhat similar construction, but of different proportions, had a wind rating 138 and a resistance rating 95.

Figs. 4 and 5 show other modifications, some complicated and some simple. No. 21 illustrates the effect of making the openings in the ventilator too small for the air to pass out freely. Its resistance rating was 56, its wind rating 85. No. 14 illustrates a very complicated construction of low resistance, resistance rating 100, wind rating 73. No. 39 is another complicated one, resistance rating 75, wind rating 77. In the case of No. 29, extending the band below the lip increased the wind rating from 91 to 113. Its resistance rating was 78. No. 48 is better than the simple types No. 2 and No. 3, but not as good as modified No. 3, its wind rating being 109 and its resistance rating 93. No. 27 is another ventilator with small exit passage for the air, its resistance rating being 50 and its wind rating 80.

These ventilators are typical of the stationary ones and the surprising fact is that the best exhaust is obtained with a very simple construction.

No. 26 is a simple type of rotary ventilator consisting of an elbow with a wind vane to hold the opening away from the wind. Its wind rating was 87, resistance rating 83. Its resistance rating is

low because of some large damper supports in the pipe which are not shown in the sketch.

Other rotary ventilators—No. 52 differs from No. 26 in that the pipe is free from obstruction and the air is deflected outward by means of a lip on the elbow. Its wind rating was 150, its resistance rating 95. No. 30 is another type in which air is permitted to pass through a passage in the ventilator. Its wind rating was 91. On stopping up the passage, the wind rating was increased to 135, so that the passage way is detrimental to the performance of this particular ventilator. No 42 also has a passageway for the air. Stopping up the passage had no effect on the wind rating, the rating remaining 149. As a result of this observation we designed the simple form No. 54. This cone type had a wind rating 149, the same as No. 42.

In conclusion, two points should be emphasized. The first is that no general statement can be made as to the relative merits of rotary and stationary, or mushroom and siphon, ventilators. The performance depends on the particular models. It is possible to build a good stationary ventilator as well as a good rotary ventilator, and there are poor ventilators of each type. The second point is that the most effective way of obtaining a large volume of air exhaust is by making use of the region of low pressure produced at the back of a properly designed obstacle. It is best not to allow the air to enter the ventilator for it must then be exhausted and will be exhausted at the expense of the air in the ventilator pipe.

Power Ventilators

Drawing No. 24

Drawing No. 24 on Page 57 illustrates typical power ventilators to which a fan, driven by an electric motor, is employed to produce positive suction of draft regardless of airflow due to temperature difference or wind suction.

The hoods in which the power ventilator is installed have the same general characteristics employed for gravity roof ventilators, namely that the construction must provide protection against the elements, must prevent downflow or backdraft when the fan is idle and provide means for anchoring the power ventilator to the roof or curb.

Fan wheels of numerous types are employed, most of the wheels being of the propeller type with few or many blades depending upon the manufacturer's engineering design. Wheels and blades may be cast, die formed, riveted or welded assemblies. Means for driving the fan may be direct drive from the motor, or offset motor employing pulleys.

Motors normally employed are totally enclosed, ball bearing, continuous heavy duty types for voltage, phase and current typical of the application.

Fig. 1 shows a type of power ventilator designed for roof mounting and conservation of space within the building. A conventional type of backward curved blade fan wheel offering non-overload motor characteristics is used. This particular type of power ventilator has a collar in which a set of louvre type dampers is incorporated to shut off air movement when the fan is idle. An electric damper control opens the louvres when the fan operates. The material employed for the housing may be galvanized steel, aluminum, copper, or other material. The fan and motor are suspended on combination rubber and spring vibration absorbers.

Fig. 2 shows a type of power roof ventilator claiming low operating noise levels with high exhaust capacity. The fan has backward curved blades. The exhaust area is oversize allowing air flow to join outer atmosphere without turbulents. The motor mounting is in a hood or chamber which can be raised for lubrication. The fan wheel used is of the centrifical blower rather than the propeller type. Automatically opening louvres can be employed where necessary. The louvres shown in Fig. 2 may be automatically or manually operated.

Fig. 3 is a combination unit with the direct drive propellor type fan mounted in the ventilator section and the louvred dampers located in a square base. The dampers may be manually or automatically operated. The double cone and wide storm band and inside baffles provide weather tightness and a minimum of air resistance. Control of the unit may be so arranged as to provide gravity exhaust without fan operation.

Fig. 4 shows a type of ventilator in which the propellor fan, direct motor driven, is located in the base equipped with access door for service. The air shaft extends above the fan and terminates in a pair of dampers which are designed to open automatically whenever the electric motor starts. The dampers are electrically operated. When the fan stops, the dampers close providing tightness against the weather with suitable gutters for removal of moisture. This unit does not function as a gravity exhaust unit. The wide storm band protects the dampers but does not seal the unit against the weather. Fig. 5 illustrates a power ventilator employing a multi-blade, pressure type fan wheel. Below the fan is a collar section incorporating automatic or manual or motor operated shutters of the multi-louvre type. In place of the storm band, this ventilator employs a dished shaped cap to provide weather protection.

Fig. 6 shows a type of power roof ventilator in which a fan unit is installed below a revolving gravity ventilator hood. This combination provides gravity exhaust during periods of moderate requirements, plus positive power exhaust on demand. The head swings on a ballbearing mounting, keeping the outlet always away from the wind. The design and construction of the revolving hood provides weather tightness. The hood operates on a ballbearing mounted in a light structural frame. The louvres in the face of the revolving hood may be motor operated and may be fully closed or fully opened or locked at any opening desired. In Fig. 6 the adjustment of the dampers is by means of a manual chain.

Fig. 7 is a type of power ventilator in which the motor is located within a top hood and drives the special type, centrifugal type blower wheel through a shaft which carries the fan bearings. Exhaust is through four rectangular shaped openings of the down-flow hood type. Manual or automatically operated louvre dampers may be installed below the fan.

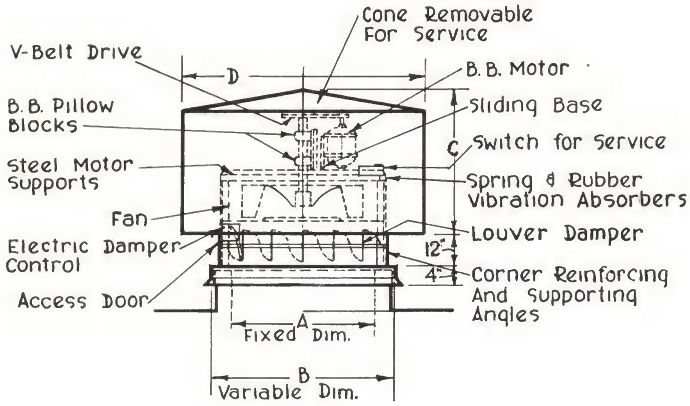


FIG. 1

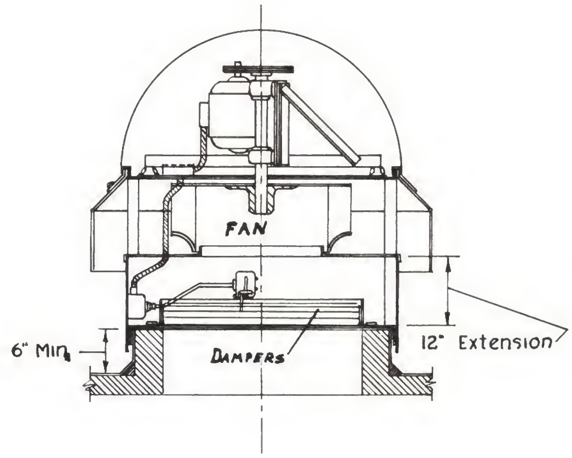
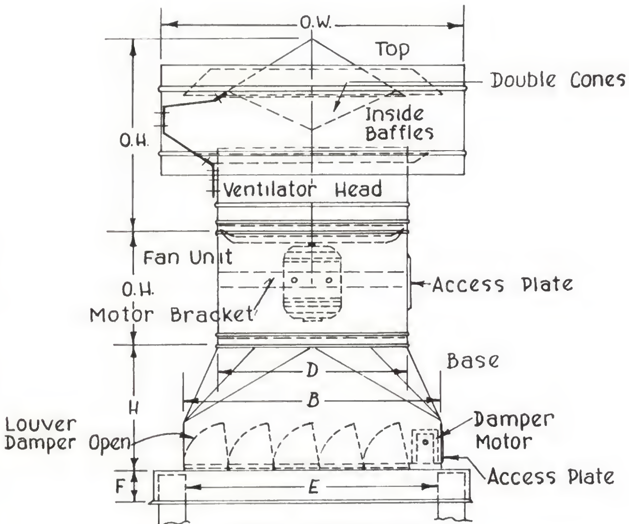
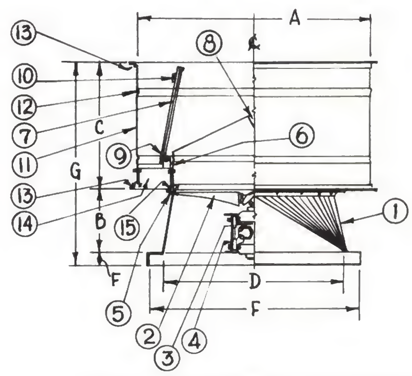


FIG. 2



Cross Section Of Power Roof Ventilator

FIG. 3



HALF SECTIONAL ELEVATION

FIG. 4

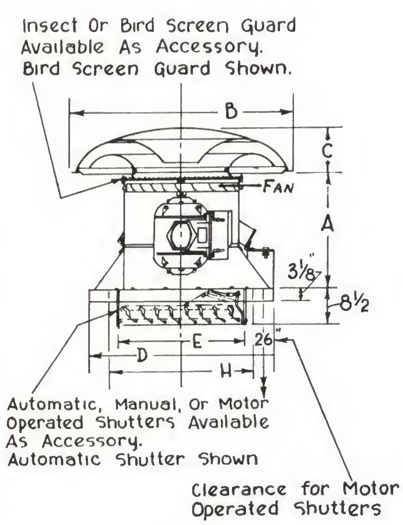


FIG. 5

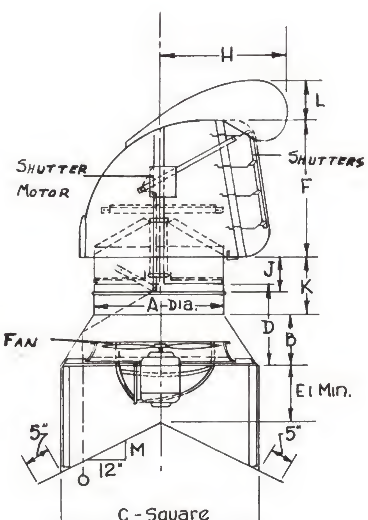


FIG. 6

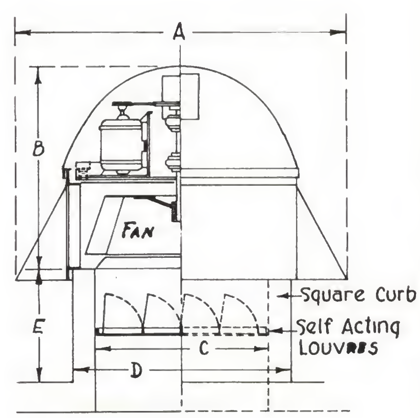


FIG. 7

DRAWING NUMBER 24

POWER VENTILATORS

Ridge Ventilators

Drawing No. 25

Drawing No. 25 on Page 59 shows typical cross sections of a type of industrial and commercial roof ventilator commonly known by the trade name "continuous ventilator."

Normally installed as a continuous ventilator or as long sections of ventilators above areas having excessive heat production, this type of ventilator is designed to provide ventilation where large volumes of air must be quickly and efficiently moved out of a building.

Designs vary considerably but in general all designs provide for a minimum of resistance to the flow of air from inside the building to outdoors; a barrier against rain and snow; structural strength to withstand wind pressures; and structural means for mounting the ventilator on different types of roofs. Construction of the ventilator sections themselves, or of supplementary bases, make it possible to mount this type of ventilator on a ridge, on a sawtooth, on a pitched roof, or on suitable curbs on flat roofs. Provision is also made for draining moisture to the upper surface of the roof. Screens to prevent birds getting into the ventilator are provided as standard or on order. Dampers in most units are designed to protect the operating mechanism and to minimize the collection of snow, leaves, cinders, or other products of combustion.

Standard sizes range from small units suitable for throat openings of approximately 4 inches to large sizes with throat openings of several feet. Standard construction is normally of 10 foot lengths and provision is made for joining standard sections together.

Fig. 1 shows a type of ventilator sheathed in corrugated material, usually galvanized iron, and designed for large throat opening in the range of 2 feet to 6 feet in width. The valves are hinged at the upper edges and an electric or chain operating mechanism is provided to close the dampers.

Fig. 2 shows a type of ridge ventilator employing wide storm bands and a high peaked cap. The damper is a continuous strip which is raised and lowered by the operating mechanism. When the damper is closed the damper rests on the upper edge of the throat. In full open position the damper is raised on guide rods.

Fig. 3 shows another type of ridge ventilator in which the dampers are hinged at the bottom and move through the space inside the storm band. The dampers are in a vertical position when closed.

Fig. 4 shows construction of ridge ventilator designed for a throat opening of 24 inches or smaller. Dampers of several types may be obtained for this ventilator. Dampers may be operated by chain or mechanical or electrical operators. Fig. 4 shows the ridge ventilator without provision for any dampers.

Fig. 5 shows a ventilator mounted on a curb such as would be employed for a flat roof. The damper in this ventilator is a flat type which to open rises vertically on guide rods, the operation being by electrical or mechanical operator or by chain control.

Fig. 6 shows another ridge ventilator designed for very large throat openings ranging from just under 3 feet to as wide a throat as 8 feet. The wind band covering in this ventilator is corrugated sheet metal of any suitable material. Heavy framing is employed to support the weight of the large dimensioned ventilator with design arranged so that none of the weight of the ventilator is carried on the sheet metal cover. The damper hinge is supported on suitable U-shaped brackets and when the dampers are open they are in a horizontal or above horizontal position. The opening of the damper also adjusts the height of the opening above the throat and into the wind box. The operating mechanism in Fig. 6 is a chain operator.

Fig. 7 is a design intended for medium throat openings (4 inches to 42 inches). The damper operates in a vertical plane resting on the throat opening when closed and positioned against the cap when fully opened. Fig. 7 illustrates installation of a ridge ventilator to structural framing of the roof.

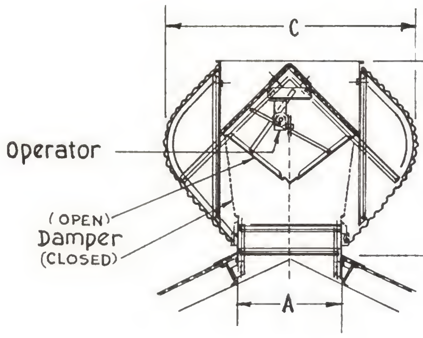
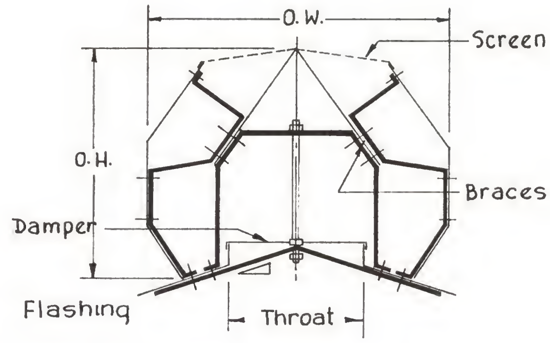
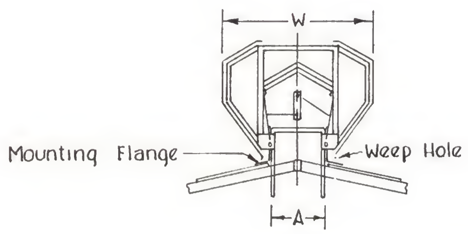


FIG. 1



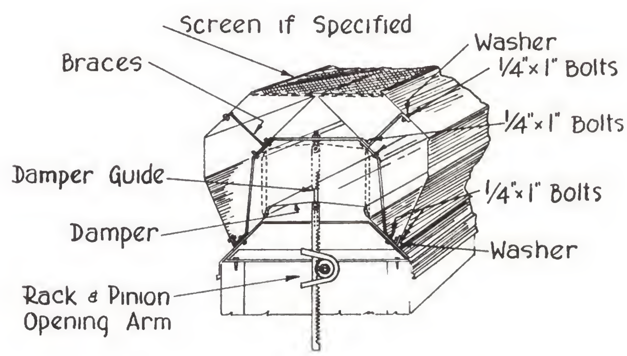
CROSS SECTION OF RIDGE ROOF VENTILATOR
SHOWING APPLICATION OF SCREEN AND DAMPER

FIG. 2



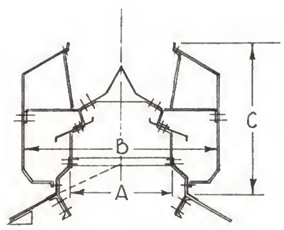
MOUNTING FOR PITCHED ROOF WITH DAMPER CLOSED

FIG. 3



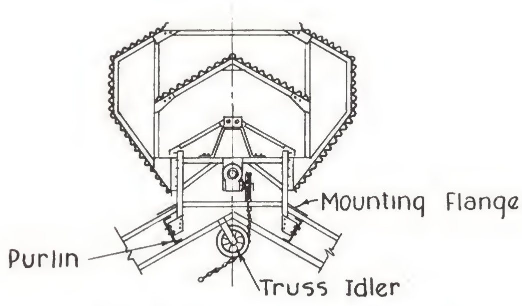
OPENING APPARATUS MANUALLY OPERATED FROM DESIRED LOCATION IN LENGTHS UP TO 50FT.

FIG. 5



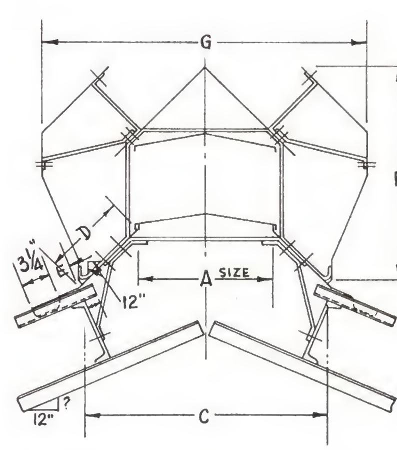
TYPE "A"

FIG. 4



TYPICAL MOUNTING FOR PITCH ROOF
SHOWS DAMPER CLOSED AND OPERATOR CONTROL

FIG. 6



NOTE: C DIMENSION MAY VARY WITH TYPE OF ROOF MATERIALS AND SIZE OF PURLINS

FIG. 7

Stage Ventilators

Drawing No. 26

Drawing No. 26 on Page 61 shows details of construction of a special type of ventilator commonly called a "stage ventilator." The name is derived from the customary use of such a ventilator, namely located on the roof above the stage of a theater. This type of ventilator is very old and has been constructed by sheet metal contractors for several generations.

The theory behind the stage ventilator is that the stage of the theater is a large open space, often times filled with highly combustible materials like scenery; any fire originating on the stage is immediately fed from large quantities of oxygen and there being no low ceilings or obstructions the normal path of the flame is to shoot upwards, spreading rapidly.

National or local codes require that the ventilator—or ventilators—shall have automatic fire doors providing a total net opening equal to 10 percent of the stage area.

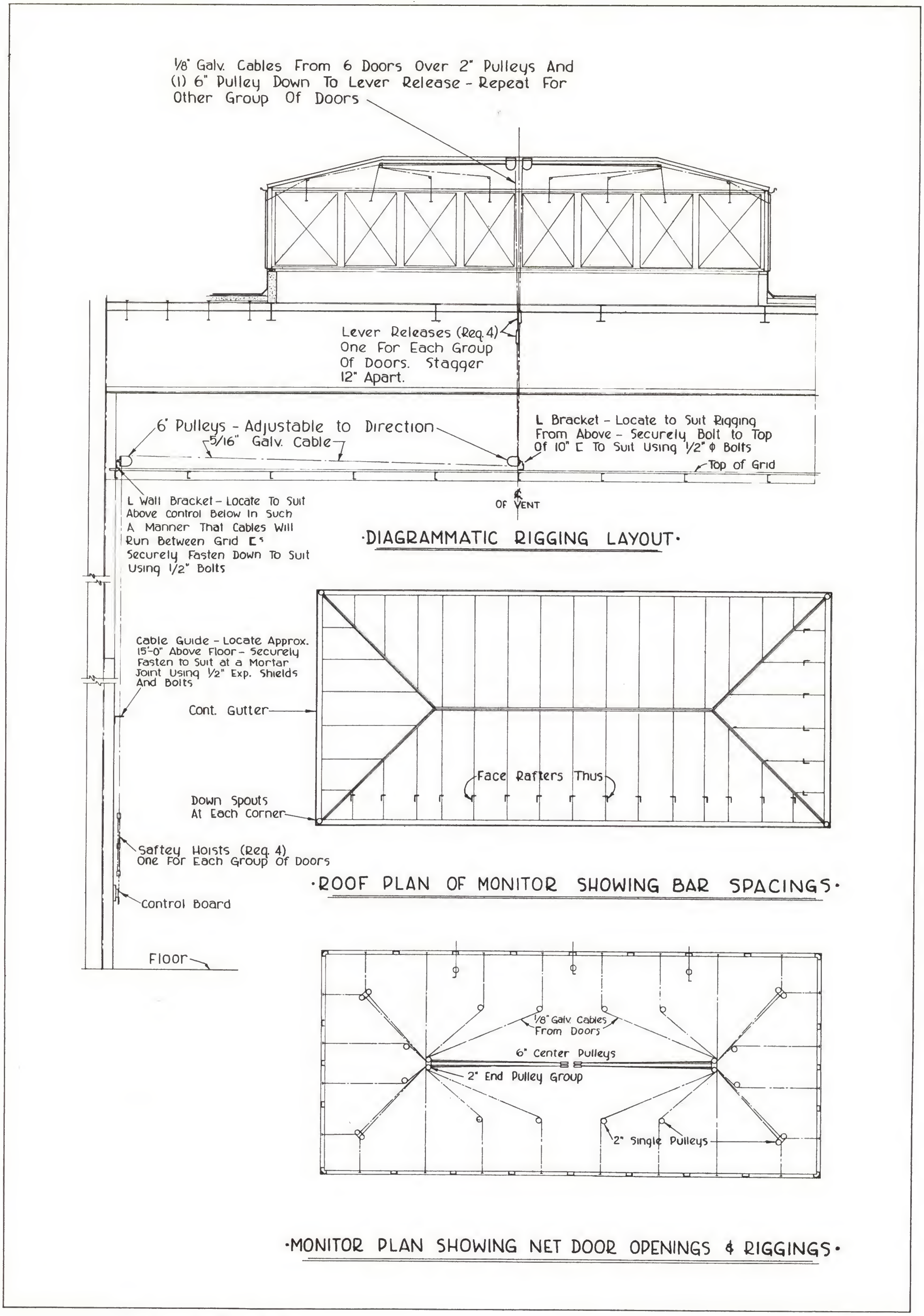
Stage ventilators normally are not supplied as factory sections but are designed according to the dimensions of the stage and the requirements of the installation. The base of the stage ventilator is a structural steel framing of columns, angles, beams, purlins, rafters, etc., as required to frame and support the stage ventilator.

If light is desired the roof of the ventilator may be glass or plastic. If light is not desired the roof may be light gauge metal, or may be any of the commonly employed types of roofing material. The ventilator is mounted on the roof on a suitable curbing with the base flashed to the roof and covered either in metal or with roofing material carried up the face of the base.

The "heart" of this construction is the doors in the sides or ends or both which are held in closed position by flexible cables running over pulleys and attached to fusable links at the doors. The other end of each cable is connected to one or more main control ropes so that the doors may be opened from the stage floor for ventilation if necessary. In case of fire, the ropes which hold the door closed may be cut or if the temperature rises sufficiently the fusable link will melt, thus allowing the door to fall open. See Drawing No. 27, Page 62.

Usually there is a jackknife bracket arm between the top of the framing and the top portion of the door which acts as a lever in thrusting doors outward and at the same time prevents the doors from opening outward beyond a certain point. The arm also holds the doors rigid against wind pressure.

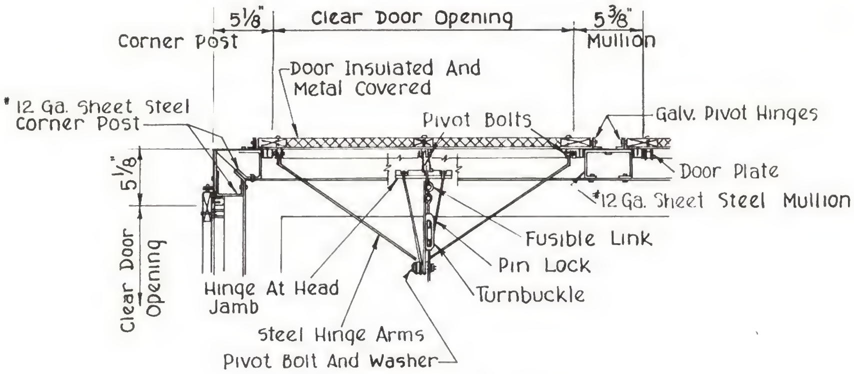
Stage ventilators are subject to approval by National Board of Fire Underwriters and by local and state fire department having jurisdiction over stage matters. Therefore, the design of the stage ventilator must conform with local and state fire laws as well as with regulations of National Board of Fire Underwriters.



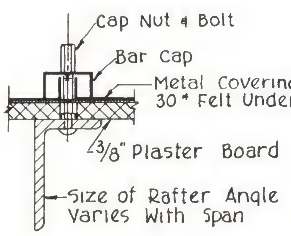
·DIAGRAMMATIC RIGGING LAYOUT·

·ROOF PLAN OF MONITOR SHOWING BAR SPACINGS·

·MONITOR PLAN SHOWING NET DOOR OPENINGS & RIGGINGS·

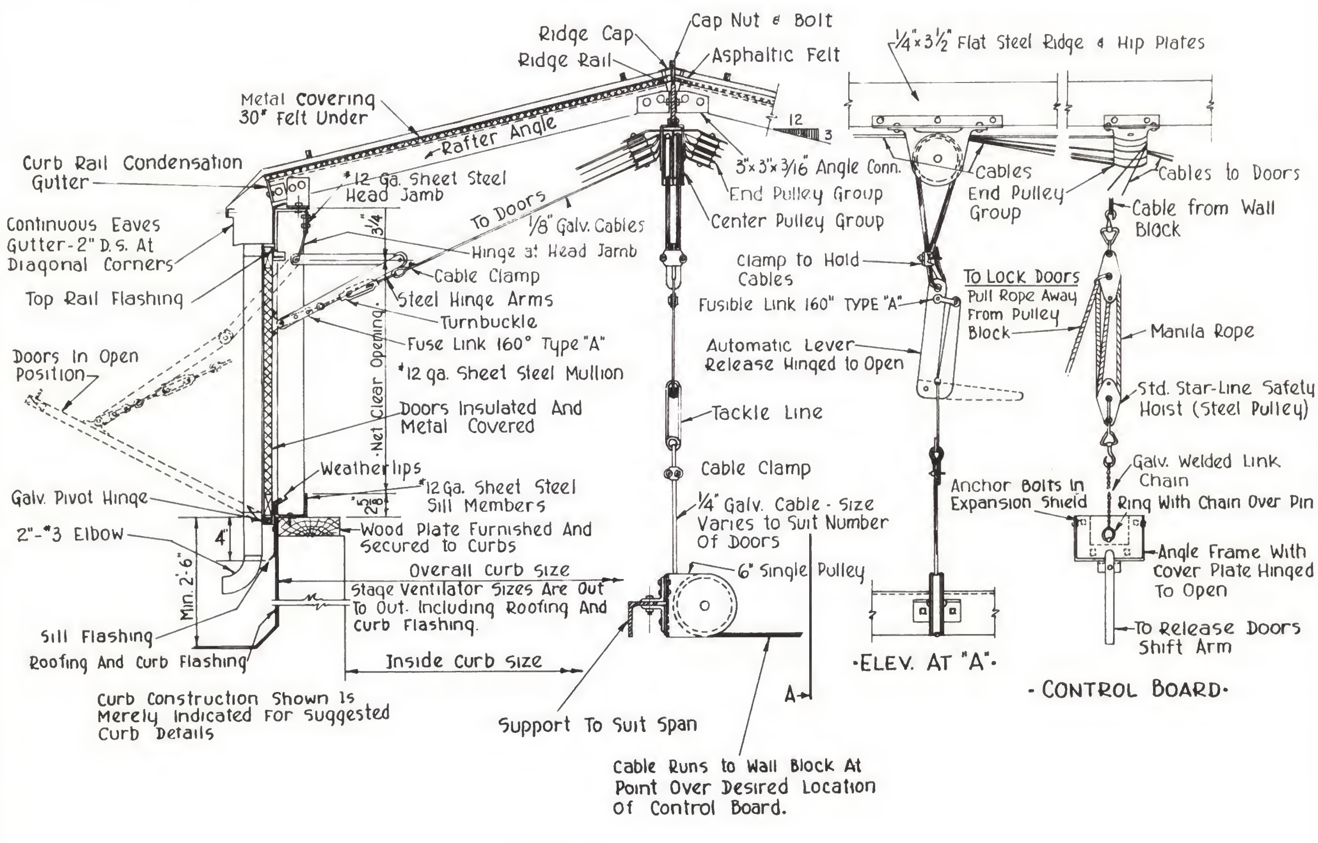


•SECTIONAL• PLAN•
•SHOWING DOOR MULLION AND CORNER POST•



•RAFTER BAR SECTION•

NOTE: Some Stages of Limited Area Only Require A Small Amount Of Exhausting Capacity. In Such Cases it is Advisable to Use Ventilators Which Will Provide The Necessary Exhausting Capacity With Side Doors Only Leaving The Ends Solid Stationary Panels. For Example an Opening 4'-0" × 8'-0" = 32 ϕ Which Could Be Provided With 2 Doors on Each Side, Each Providing 8 ϕ Of Ventilation.



•TYPICAL•
•CROSS SECTION•

Acknowledgments • Details • Photographs

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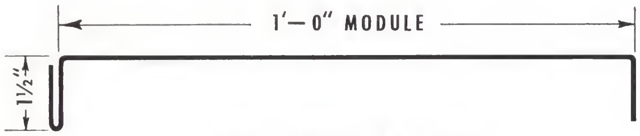
59	Fig. 1, Fig. 2—H. H. Robertson Co., Pittsburgh, Pa.
	Fig. 3—Western Engineering & Mfg. Co., Venice, Cal.
	Fig. 4—Hirschman-Pohle Co., Inc., LeRoy, N. Y.
	Fig. 5—E. Van Noorden Co., Boston, Mass.
	Fig. 6—The Burt Mfg. Co., Akron, Ohio
	Fig. 7—The Swartwout Co., Cleveland, Ohio
61-62	American 3-Way Luxfer Prism Co., Inc., Chicago, Ill.

CONSTRUCTION DETAILS *for* Drafting Room Use

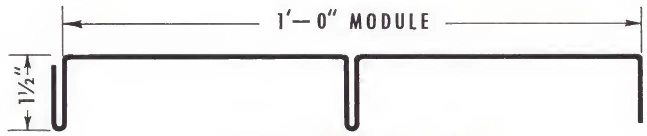
MAHON INSULATED METAL WALLS *and* STEEL DECK ROOFS

INSULATED METAL CURTAIN WALLS
and
PREFABRICATED INSULATED METAL WALL PANELS

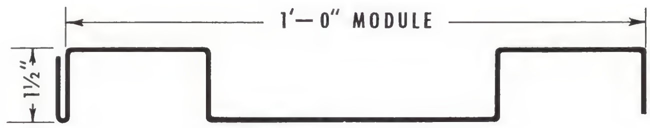
SCALE 3"=1'–0"



SINGLE RIBBED WALL PLATE



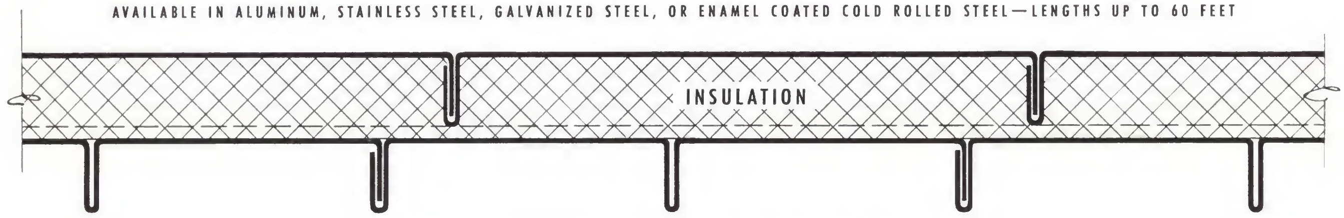
DOUBLE RIBBED WALL PLATE



FLUTED WALL PLATE

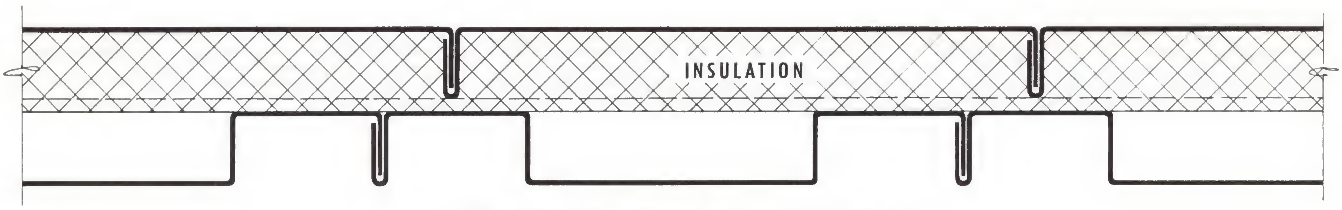
STANDARD INSULATED METAL WALL PLATES

AVAILABLE IN ALUMINUM, STAINLESS STEEL, GALVANIZED STEEL, OR ENAMEL COATED COLD ROLLED STEEL—LENGTHS UP TO 60 FEET



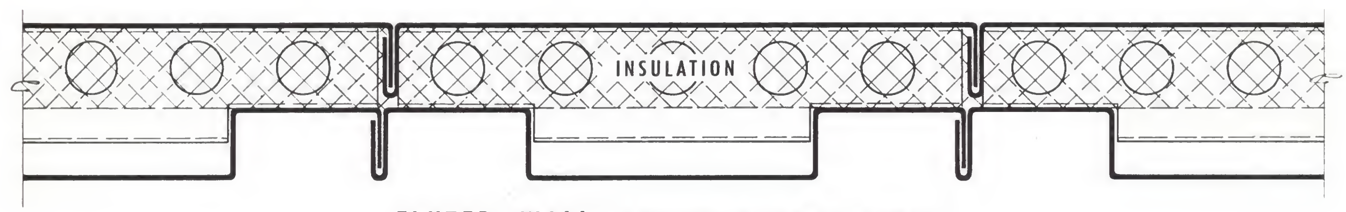
FIELD CONSTRUCTED RIBBED WALL

AVAILABLE IN ALUMINUM, STAINLESS STEEL, GALVANIZED STEEL, OR ENAMEL COATED COLD ROLLED STEEL—LENGTHS UP TO 60 FEET



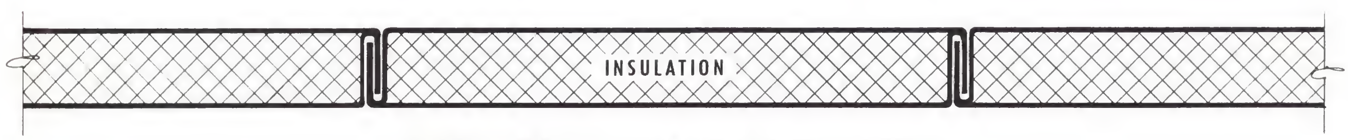
FIELD CONSTRUCTED FLUTED WALL

AVAILABLE IN ALUMINUM, STAINLESS STEEL, GALVANIZED STEEL, OR ENAMEL COATED COLD ROLLED STEEL—LENGTHS UP TO 60 FEET



FLUTED WALL (PREFABRICATED WALL PANELS)

AVAILABLE IN ALUMINUM, STAINLESS STEEL, GALVANIZED STEEL, OR ENAMEL COATED COLD ROLLED STEEL—LENGTHS UP TO 30 FEET

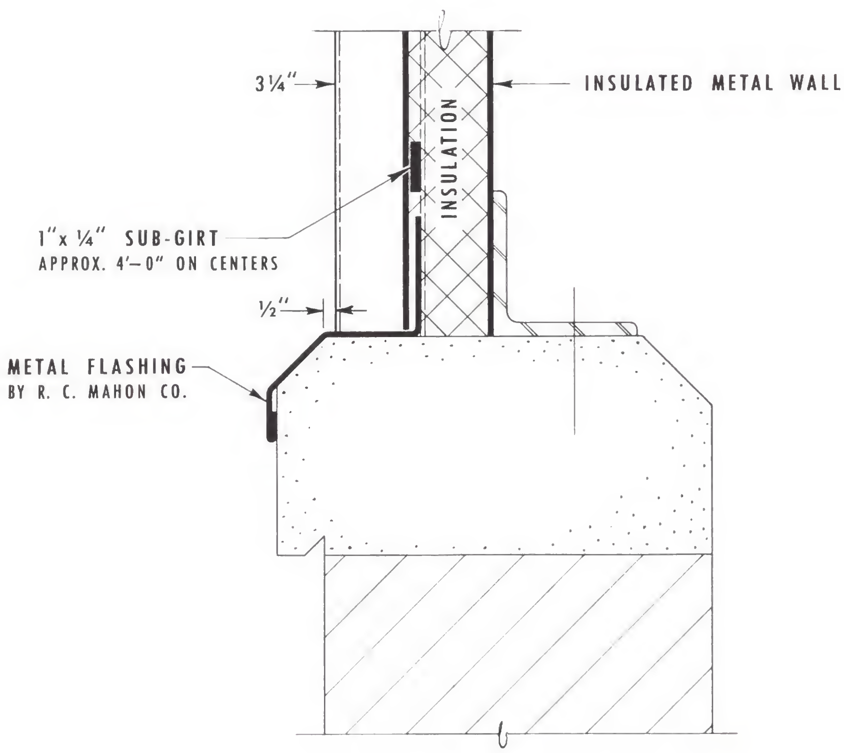


FLUSH WALL (PREFABRICATED WALL PANELS)

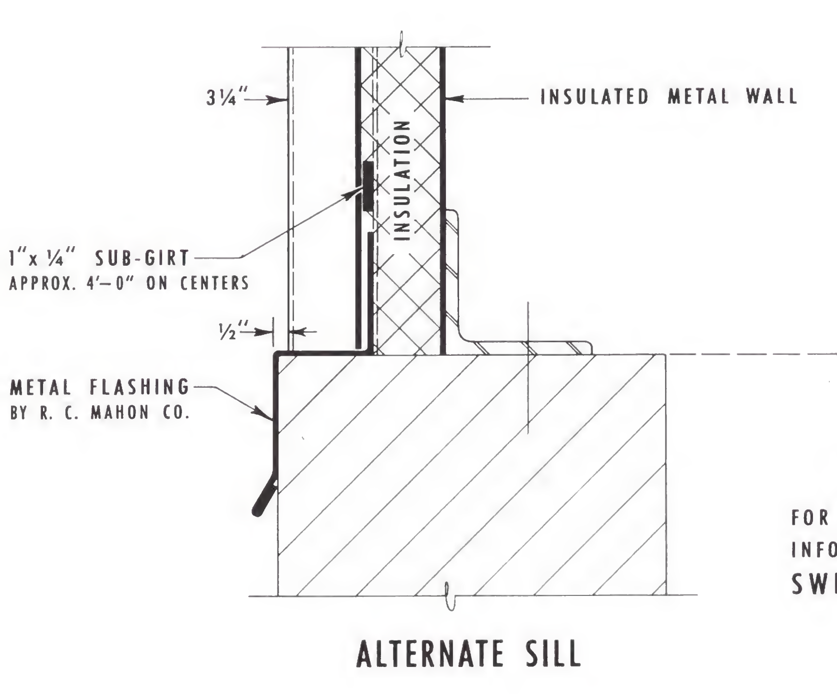
AVAILABLE IN ALUMINUM, GALVANIZED STEEL, OR ENAMEL COATED COLD ROLLED STEEL—LENGTHS UP TO 30 FEET

SILL DETAILS

SCALE 3"=1'-0"



SILL



NOTE:
FOR ADDITIONAL INFORMATION SEE SWEET'S FILE

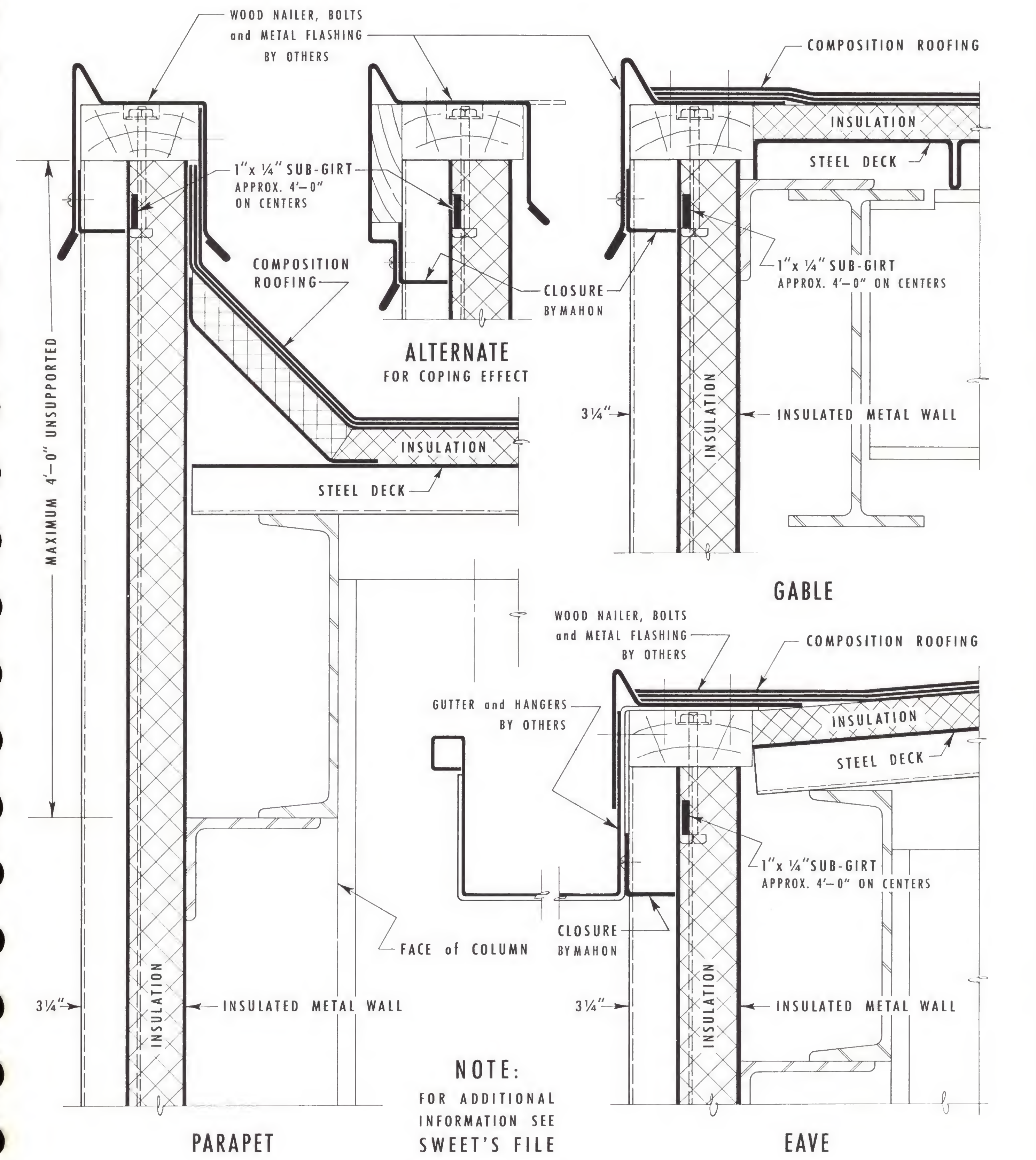
ALTERNATE SILL

CONSTRUCTION DETAILS *for* Drafting Room Use

MAHON INSULATED METAL WALLS *and* STEEL DECK ROOFS

EAVE and GABLE DETAILS

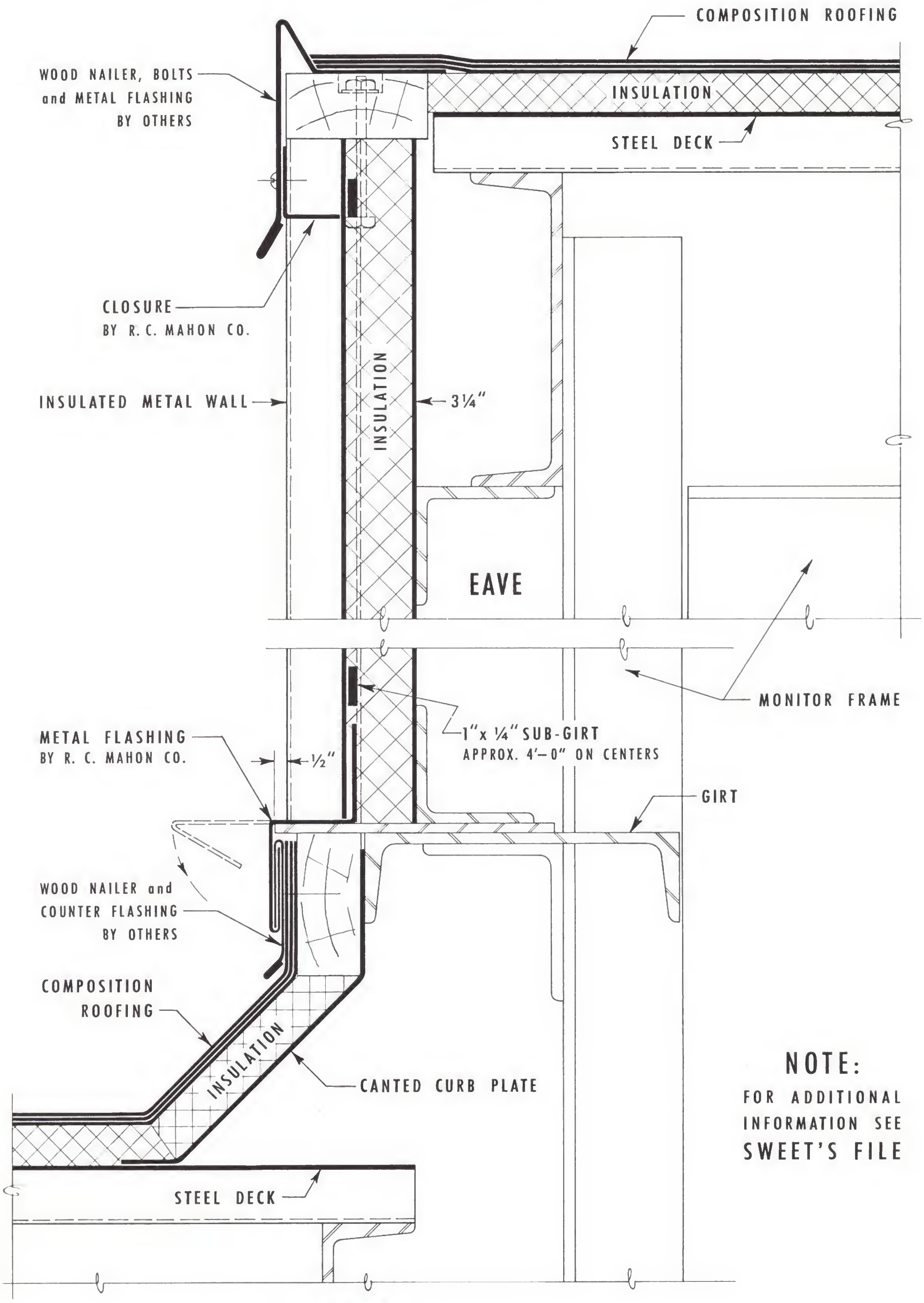
SCALE 3″=1′–0″



NOTE:
FOR ADDITIONAL INFORMATION SEE SWEET'S FILE

MONITOR DETAILS

SCALE 3"=1'–0"

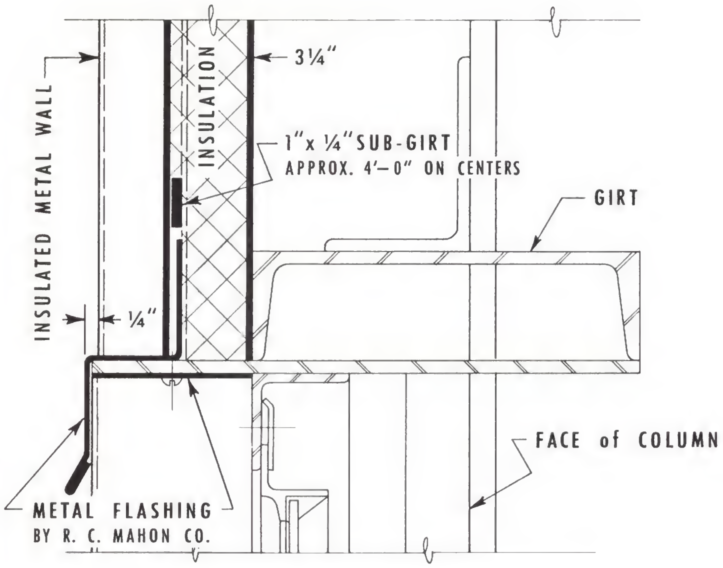


CURB

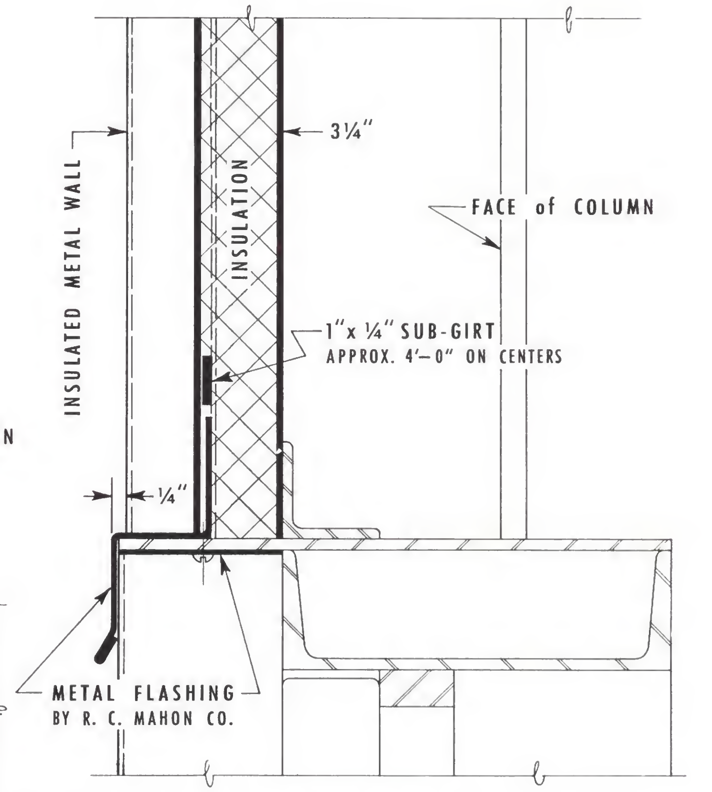
NOTE:
FOR ADDITIONAL INFORMATION SEE SWEET'S FILE

OPENING DETAILS

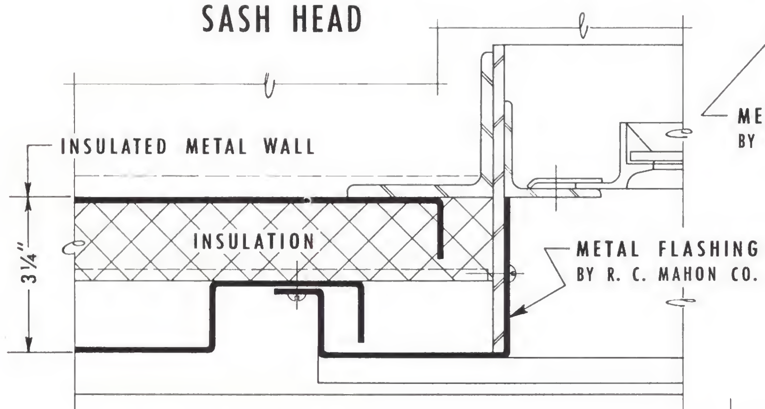
SCALE 3″=1′–0″



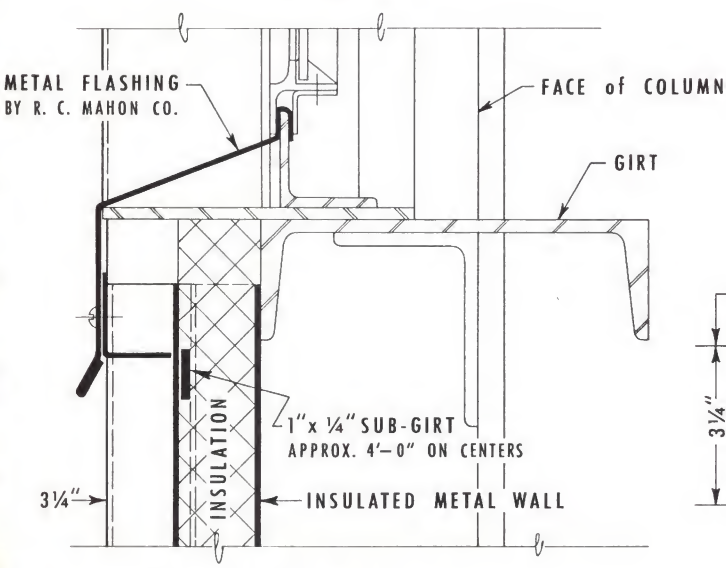
SASH HEAD



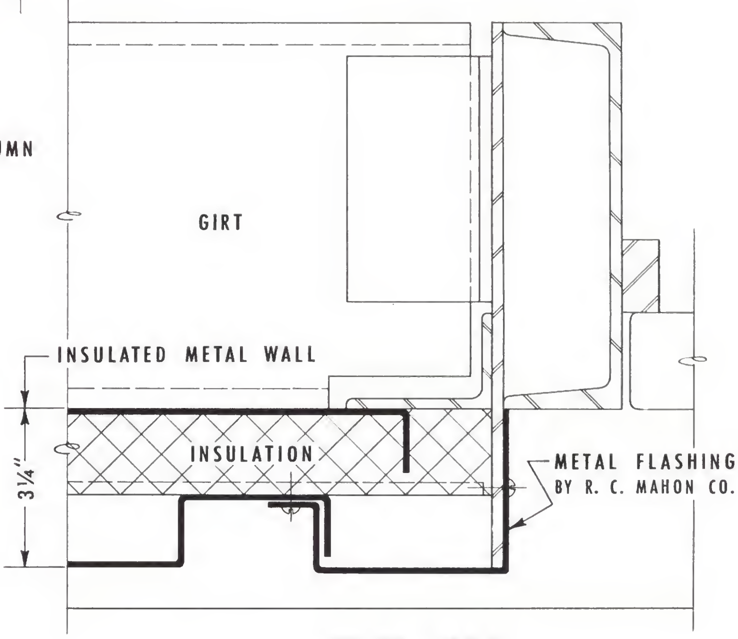
DOOR HEAD



SASH JAMB



SASH SILL

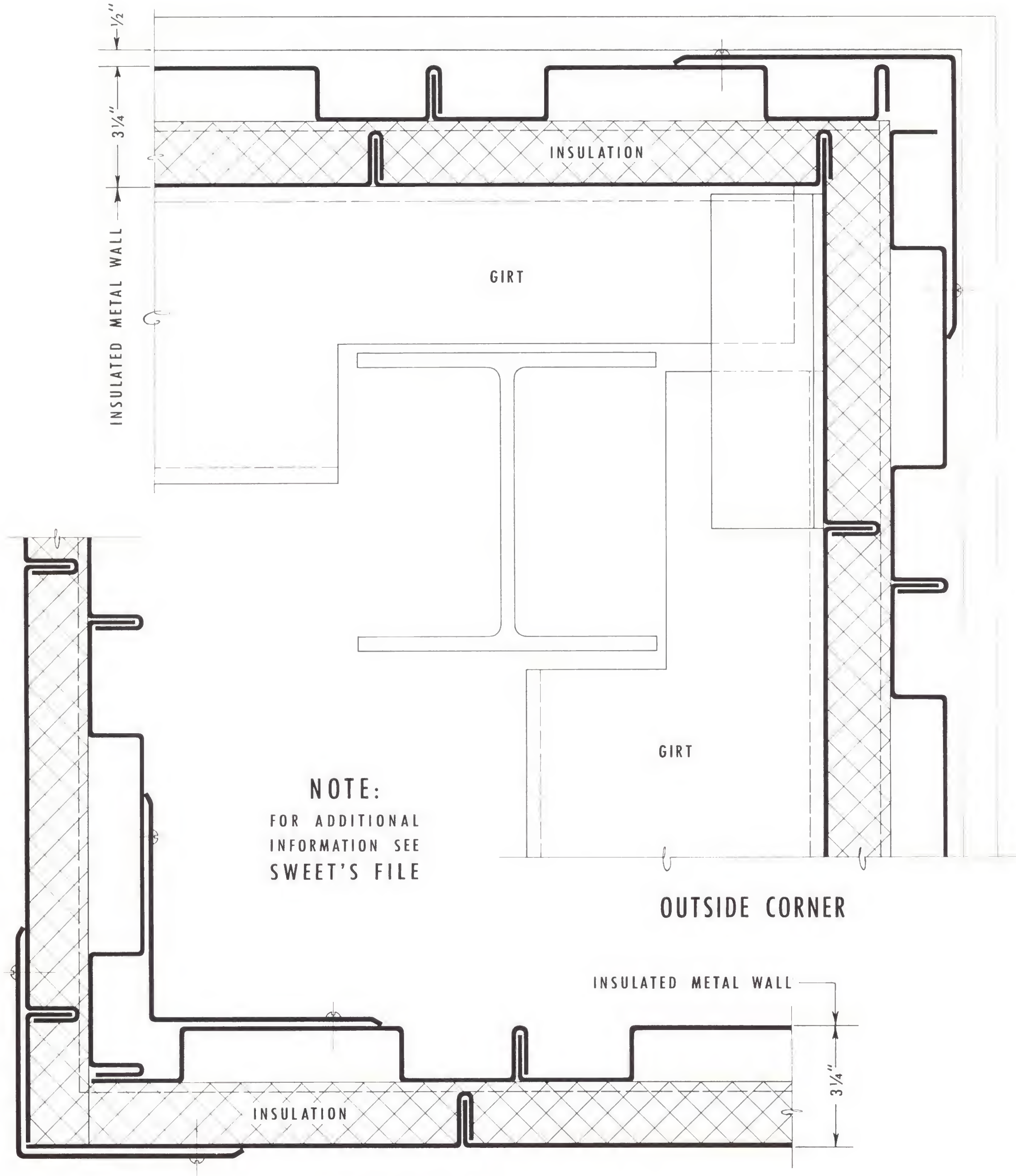


DOOR JAMB

CORNER DETAILS

FIELD CONSTRUCTED FLUTED WALL

SCALE 3" = 1'–0"



NOTE:
FOR ADDITIONAL INFORMATION SEE SWEET'S FILE

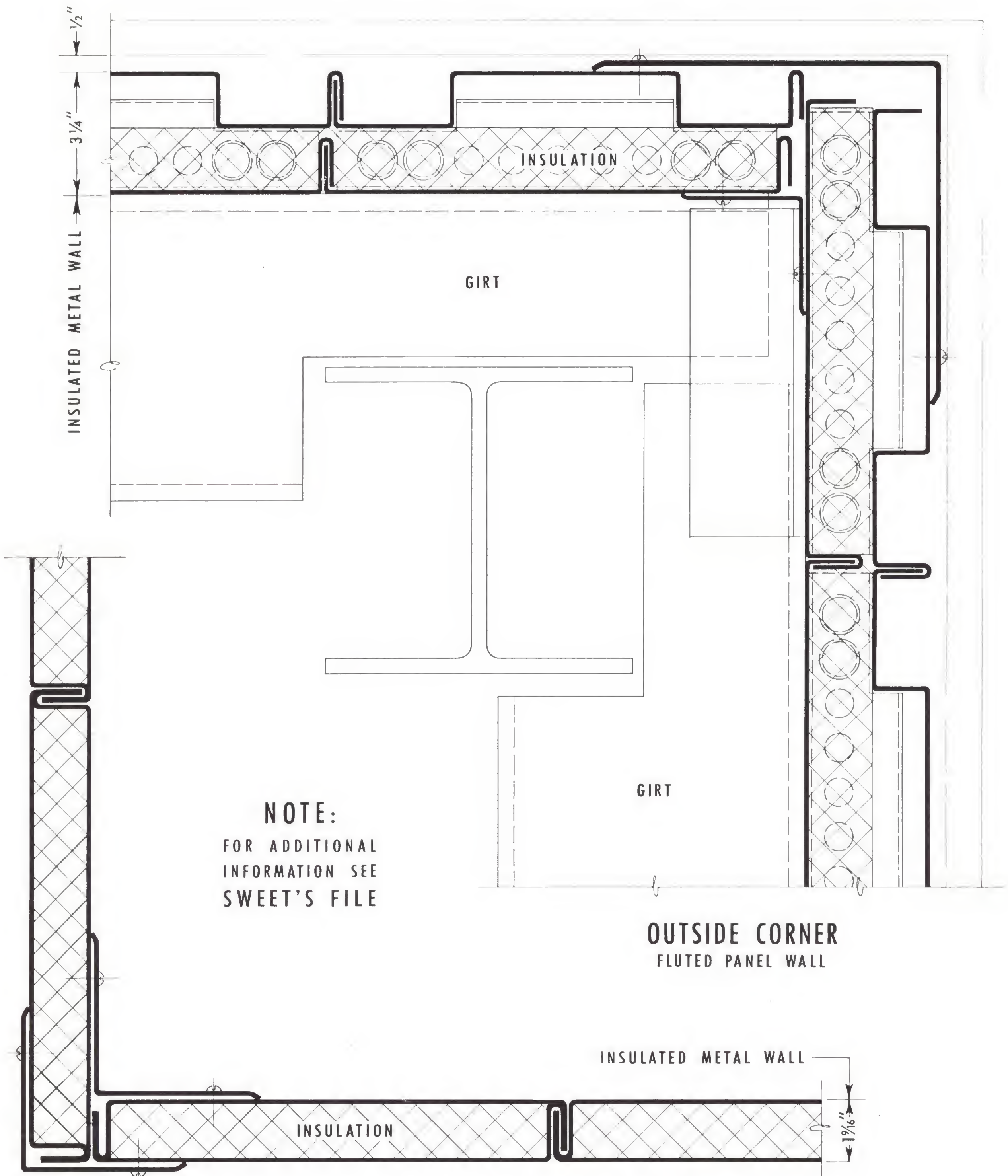
OUTSIDE CORNER

INSIDE CORNER

CORNER DETAILS

PREFABRICATED METAL WALL PANELS

SCALE 3"=1'-0"



NOTE:
FOR ADDITIONAL INFORMATION SEE SWEET'S FILE

OUTSIDE CORNER
FLUTED PANEL WALL

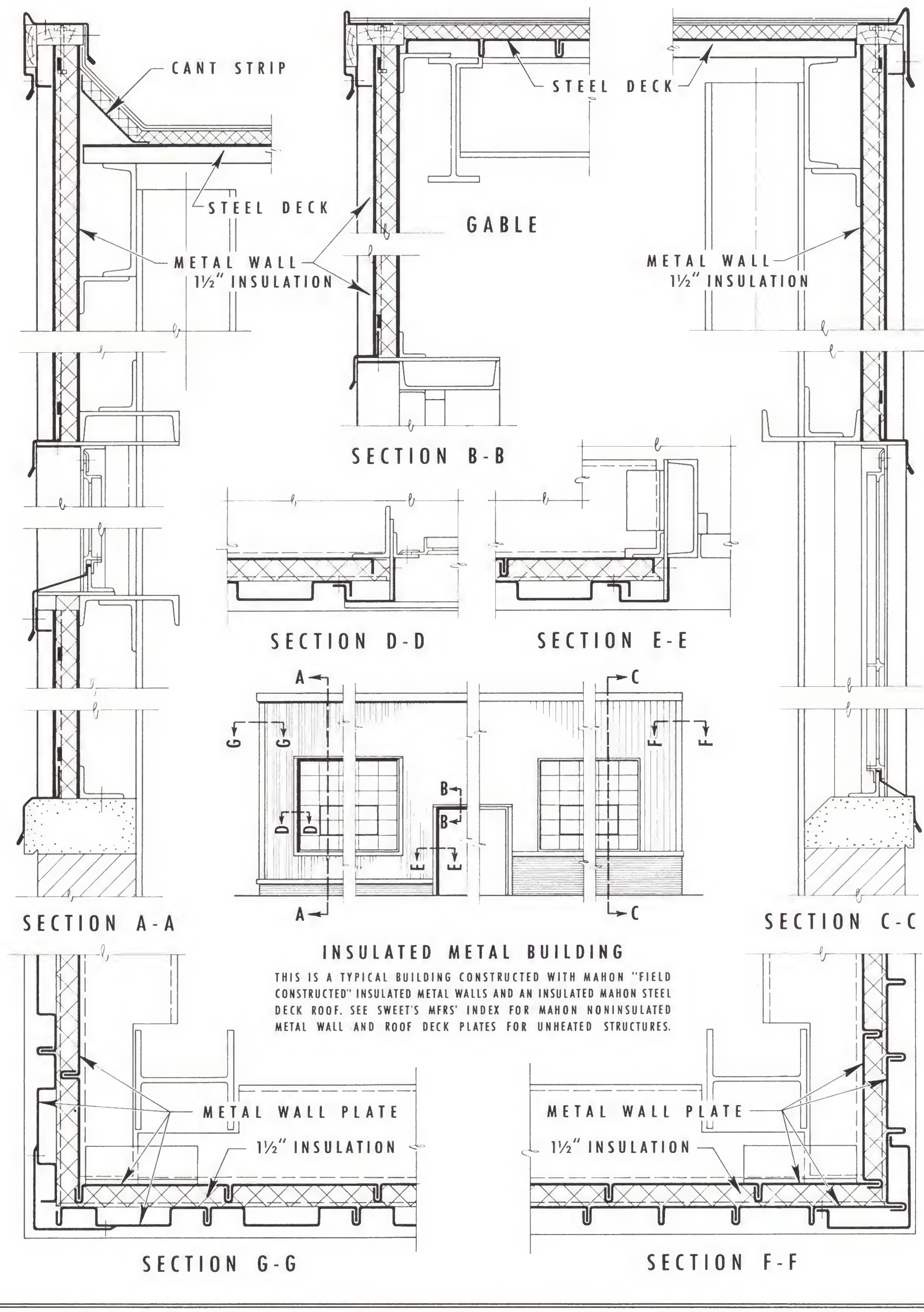
OUTSIDE and/or INSIDE CORNER
FLUSH PANEL WALL

CONSTRUCTION DETAILS *for* Drafting Room Use

MAHON INSULATED METAL WALLS *and* STEEL DECK ROOFS

TYPICAL CONSTRUCTION DETAILS

SCALE 1″= 1′– 0″



INSULATED METAL BUILDING

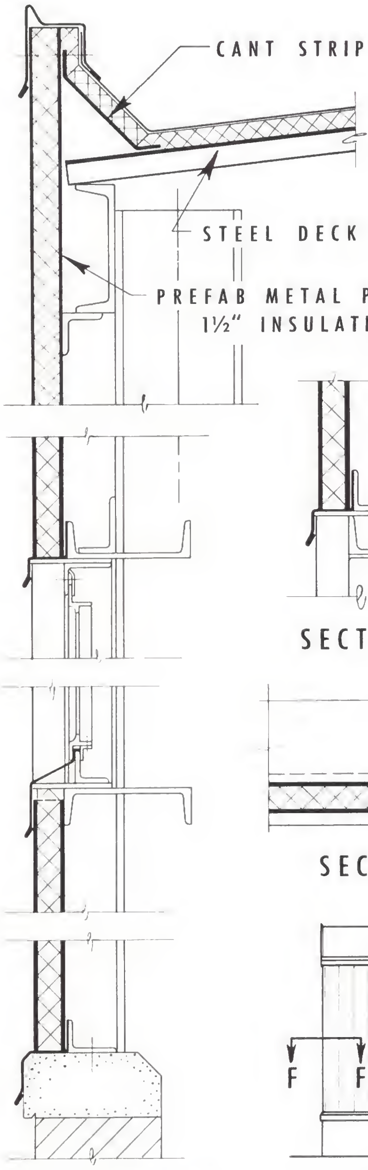
THIS IS A TYPICAL BUILDING CONSTRUCTED WITH MAHON "FIELD CONSTRUCTED" INSULATED METAL WALLS AND AN INSULATED MAHON STEEL DECK ROOF. SEE SWEET'S MFRS' INDEX FOR MAHON NONINSULATED METAL WALL AND ROOF DECK PLATES FOR UNHEATED STRUCTURES.

CONSTRUCTION DETAILS *for* Drafting Room Use

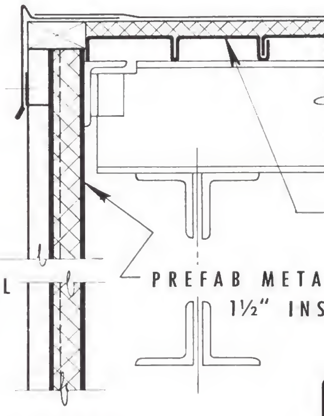
MAHON INSULATED METAL WALLS *and* STEEL DECK ROOFS

TYPICAL CONSTRUCTION DETAILS

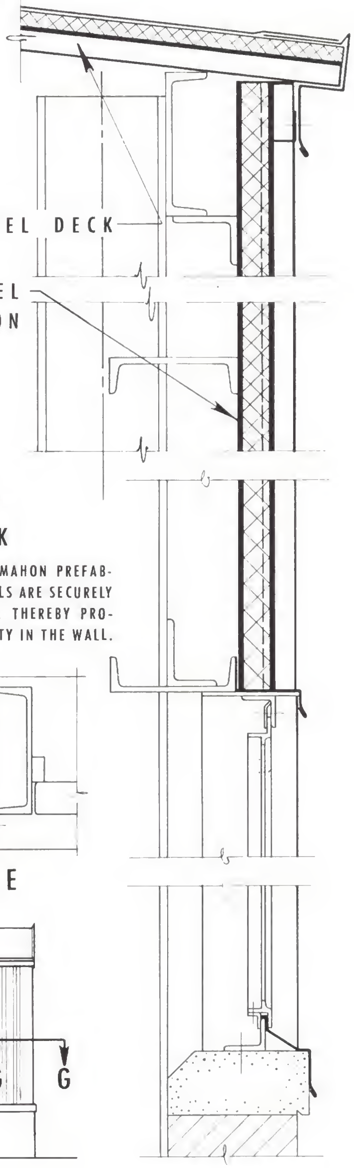
SCALE 1" = 1' – 0"



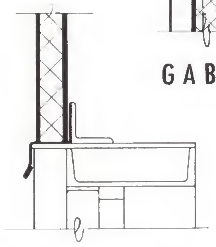
SECTION A-A



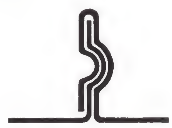
GABLE



SECTION B-B

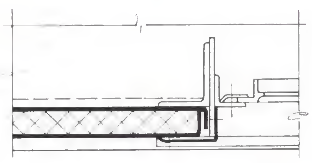


SECTION C-C

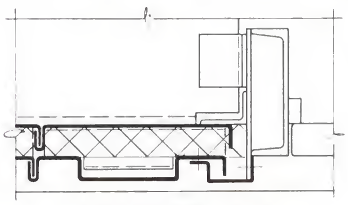


CLINCH LOCK

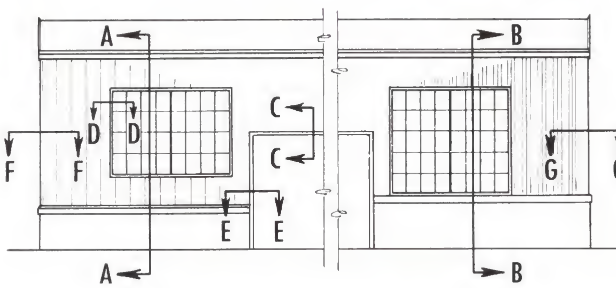
THE OUTSIDE INTERLOCKING RIBS OF MAHON PREFABRICATED INSULATED METAL WALL PANELS ARE SECURELY LOCKED TOGETHER IN THIS MANNER, THEREBY PROVIDING EXCELLENT LATERAL CONTINUITY IN THE WALL.



SECTION D-D

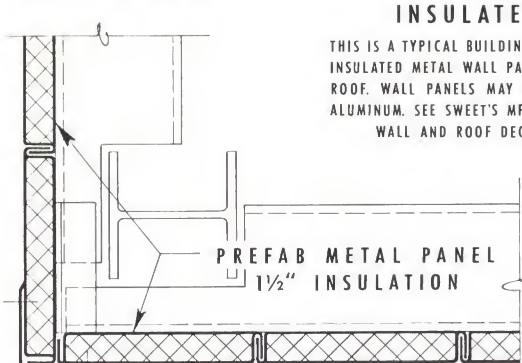


SECTION E-E

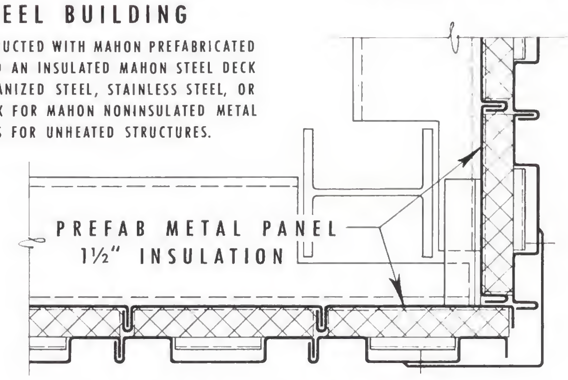


INSULATED STEEL BUILDING

THIS IS A TYPICAL BUILDING CONSTRUCTED WITH MAHON PREFABRICATED INSULATED METAL WALL PANELS AND AN INSULATED MAHON STEEL DECK ROOF. WALL PANELS MAY BE GALVANIZED STEEL, STAINLESS STEEL, OR ALUMINUM. SEE SWEET'S MFRS' INDEX FOR MAHON NONINSULATED METAL WALL AND ROOF DECK PLATES FOR UNHEATED STRUCTURES.



SECTION F-F



SECTION G-G

CONSTRUCTION DETAILS *for* Drafting Room Use

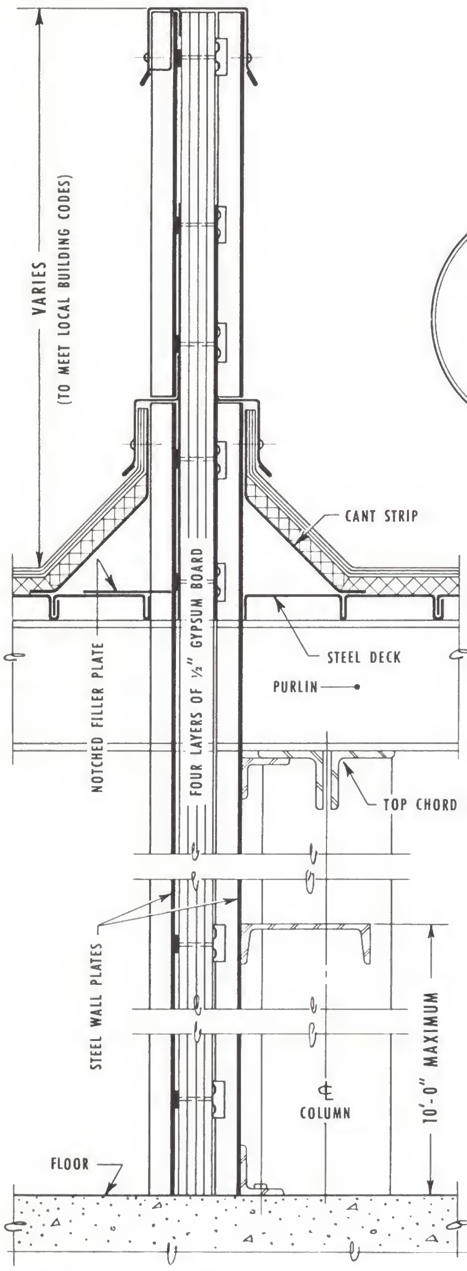
MAHON UNDERWRITERS' RATED METALCLAD FIRE WALLS

METALCLAD FIRE WALLS

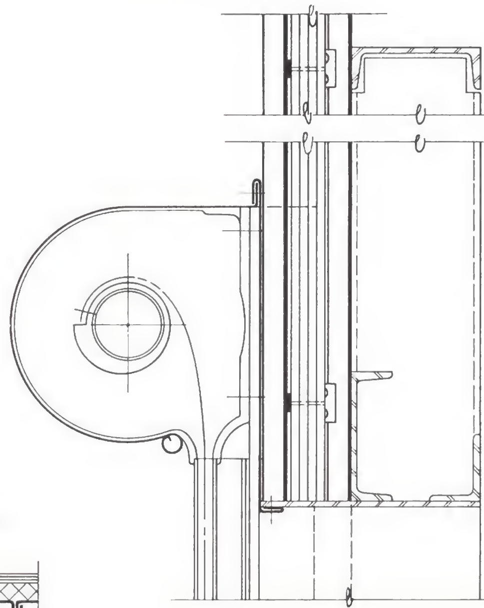
UNDERWRITERS' RATED

INTERIOR DIVIDING-WALL TYPE • EXTERIOR CURTAIN-WALL TYPE

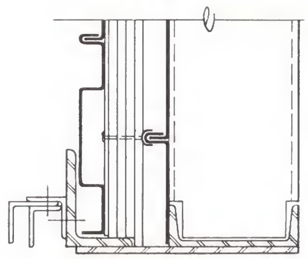
SCALE 1" = 1'– 0"



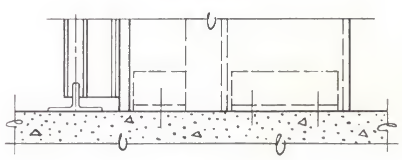
INTERIOR DIVIDING FIRE WALL



HEAD



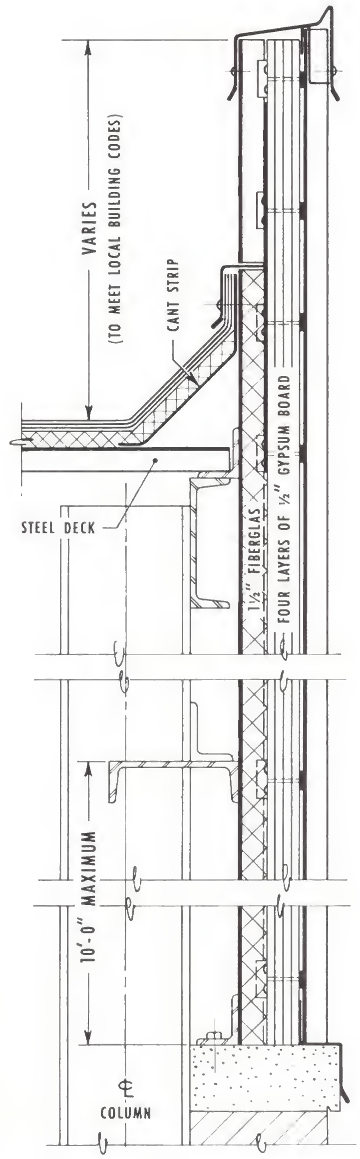
JAMB



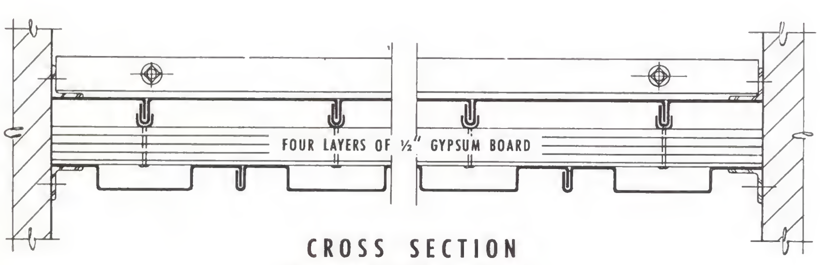
SILL

OPENING DETAILS

FOR MAHON UNDERWRITERS' LABELED AUTOMATIC ROLLING STEEL FIRE DOOR

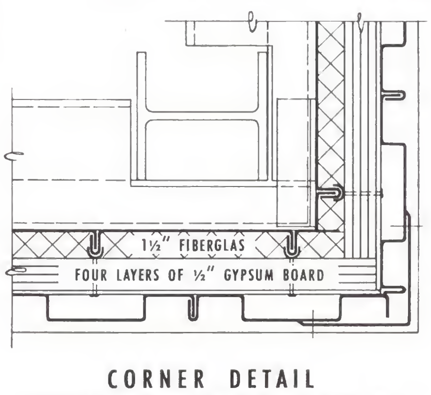


EXTERIOR INSULATED CURTAIN-TYPE FIRE WALL



CROSS SECTION

INTERIOR DIVIDING FIRE WALL



CORNER DETAIL

EXTERIOR INSULATED CURTAIN-TYPE FIRE WALL

FABRICATION

TYPE OF SHEET METAL	COMPARATIVE COST AT 1000 LB. BRACKET PER LB.	COMPARATIVE WGT. PER GAE. 16 OZ. C.R. COPPER AS 100% .0216	FORMING	SOLDERING	WELDING
COMMERCIAL COPPER (TOUGH PITCH) 99.9 + COPPER .0026 OXYGEN	$ .74	100%	180° HEM AND CAN BE LOCK FORMED	SAME AS GALVANIZED IRON	SPOT WELDING BRAZING
COMMERCIAL ALUMINUM 3003,-3004,-6063, 6061, 1100	$ .569	.361%	180° HEM AND CAN BE LOCK FORMED	NOT PERFECTED YET	SPOT WELDING .040 ALUM. IS LIGHTEST GAUGE ALLOWABLE FOR GAS WELDING
ZINC ALLOY COPPER 0.8 TO 1.2% MAGNESIUM 0.003 TO 0.016%-ZINC BALANCE	$ .483	.75%	.018 THICK AND HEAVIER GAUGE CAN BE FORMED WITH 180° HEM WILL TAKE LOCK FORMING	SAME AS GALVANIZED IRON	SPOT WELDING GAS WELDING
MONEL 70% NICKEL 30% COPPER	$1.26 LB WHSE. PRICE ROOFING SHEET	.97%	SAME AS GALVANIZED IRON	SAME AS GALVANIZED IRON EXCEPT SOLDERING IRON MUST BE EXTREMLY HOT	SAME AS GALVANIZED IRON
BRASS COPPER 70% ZINC 30%	$ .70	.996%	SAME AS GALVANIZED IRON	SAME AS GALVANIZED IRON	SPOT WELDING BRAZING
ALUM.-BRONZE (SHEET 20" WIDE MAX.) COPPER 92% ALUM. 8%	$1.54	.89%	VERY POOR WORKING QUALITIES	RESULTS-FAIR SPECIAL #1200 FLUX SHOULD BE USED WITH SILVER SOLDER	SPOT WELDING BRAZING, ARC WELDING
PHOSPHOR (TIN) BRONZE (SHEET 6" WIDE MAX.) COPPER 92% TIN 8%	$1.60	.9262%	SAME AS GALVANIZED IRON	RESULTS-EXCELLENT #1200 FLUX + SILVER SOLDER	SPOT WELDING BRAZING ARC. WELDING
LEAD	$34.88	.125%	WILL FORM TO ANY SHAPE	SAME AS GALVANIZED IRON	TOO LOW A MELTING POINT FOR ANY TYPE OF WELDING
BLACK IRON (COLD ROLLED)	$ .12	100%	SAME AS GALVANIZED IRON	SAME AS GALVANIZED IRON EXCEPT NON-CUT MURATIC ACID FOR FLUX	SAME AS GALVANIZED IRON
STAINLESS STEEL 18-8 EXTERIOR 17 INTERIOR	$ .756	.80%	18-8 TYPE 302 180° HEM & CAN BE LOCK FORMED 50% TO 60% ELONGATION BEFORE BREAKING 17-TYPE 430 20% to 35% ELONGATION BEFORE BREAKING	SOLDER WITH LEAD TIN SOLDER(SOFT) SILVER SOLDER(HARD) MAKES BETTER JOINT RECOMMENDED WHERE APPEARANCE IS CRITICAL LEAD TIN SOLDER NOT RECOMMENDED WHERE MECH. STRESS IS FACTOR	SPOT WELDING, BRAZING, ARC WELDING
GALVANIZED IRON COMMERCIAL QUALITY .A93	$ .13	.906%	180° HEM AND CAN BE LOCK FORMED	CLEANED OF ALL DIRT, GREASE & OXIDE. CUT HYDROCHLORIC ACID (MURATIC) MAKES THE BEST. FLUX-50% TIN & 50% LEAD SOLDER SHOULD BE USED WITH HEAVY SOLDERING IRON	SPOT WELDING, BRAZING, ARC WELDING

CONSTRUCTION SHEET METAL SPECIFICATION GUID

INSTALLATION

FASTNERS	FINISHES	APPEARANCE AFTER WEATHERING	AVAILABILITY	MAINTENANCE	COEFFICIENT OF THERMAL EXPANSION	ELECTROLYTIC POTENTIAL
MED. TEMPER RIVETS COPPER NAILS	COLD ROLLED-BRIGHT ANNEALED-(SOFT)-DULL CAN BE POLISHED TO A BRIGHT FINISH MUST BE LACQUERD TO RETAIN FINISH	VERTIGRE GREEN	STANDARD WAREHOUSE ITEM	NONE, EXCEPT IF BRIGHT FINISH IS REQUIRED- MUST BE LACQUERD & POLISHED	77° - 572° F° .0000098 PER DEGREE F°	.22
MED. TEMPER ALUM. RIVETS ALUM. NAILS ALUM. SCREWS. STAINLESS STEEL MAY BE SUBSTITUTED	BRIGHT- ANODIZING RETAINS THE BRIGHT FINISH	RETAINS NATURAL ALUM. COLOR DULLING IN TIME DEPENDING ON ATMOSPHERIC CONDITIONS	STANDARD WAREHOUSE ITEM	WHERE ALUM. CAN BE KEPT CLEAN IT REDUCES OXIDATION ANODIZED ALUM. REQUIRES LESS MAINTENANCE	68° - 212° F° .0000129 PER DEGREE F°	.75
SAME AS GALVANIZED IRON	BRIGHT	DULL GRAY	WAREHOUSED IN LARGE CITIES ONLY	NONE	PER DEGREE C .000029	1.09
MONEL RIVETS, SCREWS, BOLTS, & NAILS, SHOULD BE USED	POLISHED FINISH COLD ROLLED SPECIAL ROOFING SHEET HOT ROLLED	SMOOTH,GRAY-GREEN FILM(OUTDOOR EXPOSURE) RETAINS BRIGHTNESS FOR INDOOR APPLICATION	WAREHOUSE OR MILL	NONE IF OXIDE COATING CAN BE TOLERATED.	PER DEGREE C .000014	.10
MED. TEMPER RIVETS COPPER NAILS	COLD ROLLED-BRIGHT ANNEALED (SOFT)-DULL CAN BE POLISHED TO A BRIGHT FINISH MUST BE LACQUERD TO RETAIN FINISH	VERTIGRE GREEN	STANDARD WAREHOUSE ITEM	NONE EXCEPT IF BRIGHT FINISH IS REQUIRED MUST BE LACQUERD & POLISHED	77° - 572° F° .0000114 PER DEGREE F°	.22
NAVAL BRASS RIVETS, SCREWS BOLTS & NAILS	BRIGHT FINISH CAN BE POLISHED FOR BRIGHTER FINISH	VERTIGRE GREEN	MILL ORDER ONLY-90 TO 100 DAYS DELIVERY	NONE EXCEPT IF BRIGHT FINISH IS REQUIRED MUST BE LACQUERD & POLISHED	77° - 572° F° .0000099 PER DEGREE F°	.20
NAVAL BRASS RIVETS, SCREWS BOLTS & NAILS	MED. BRIGHT CAN BE POLISHED TO BRIGHT LUSTER	VERTIGRE GREEN	ONLY A FEW WAREHOUSES IN IN MAJOR CITIES ONLY	NONE EXCEPT IF BRIGHT FINISH IS REQUIRED MUST BE LACQUERD & POLISHED	77° - 572° F° .0000099 PER DEGREE F°	.20
LEAD CLAD OR COPPER RIVETS, SCREWS, NUTS BOLTS & NAILS	DULL GRAY	DULL GRAY	STANDARD WAREHOUSE ITEM	NONE	PER DEGREE C .000029	.51
STEEL NAILS, RIVETS, SCREWS NUTS & BOLTS	DULL GRAY TO BLACK		STANDARD WAREHOUSE ITEM	REQUIRES PAINTING	32° to 212° F° .0000066 PER DEGREE F°	.55
STAINLESS STEEL RIVETS, SCREWS, & BOLTS	2B ANNEALED COLD ROLLED- BRIGHT FINISH CAN BE POLISHED 2D-DULL C. R.FINISH 2D-SPECIAL FOR ARCHITECTURAL WORK. HAS A SATIN FINISH TO REDUCE GLARE #4-GROUND FINISH	18-8 RETAINS BRIGHT NESS IF CLEANED PERIODICALLY 17-CR430 WILL SHOW RED RUST IF NOT PROPERLY CLEANED OR IF MATERIAL BECOMES CONTAMINATED DUE TO SALT AIR & DUST CARRYING FREE IRON	STANDARD WAREHOUSE ITEM	SHOULD BE CLEANED PERIODICALLY IF BRIGHTNESS IS TO BE MAINTAINED	32° - 212° F° 18-8 - 9.6 x 10-6 .0000096 PER DEGREE F° 17 - 5.8 x 10-6 .0000058 PER DEGREE F°	.53
HOT DIPPED GALVANIZED NAILS & RIVETS	ZINC DIPPED-BRIGHT ZINC PLATED-DULL	DULL GRAY TO WHITISH POWDER FILM	STANDARD WAREHOUSE ITEM	REQUIRES PAINTING	32° - 212° F° .0000066 PER DEGREE F°	1.09

YEAR TEST
A. S. T. M.

ATMOSPHERIC CORROSION

NON FERROUS METALS ONLY

INDUSTRIAL - ALTOONA PA.				SEACOAST - LA JOLLA, CALIF.				INLAND - PHOENIX, ARIZ.			
erage nge of t. in cent	Average Corrosive Rate Mil Per Yr.	Loss of Tensile Strength	Ductility Elongation in 2 inch percent	Average change of Wght. in percent	Average Corrosive Rate Mil Per Yr.	Loss of Tensile Strength	Ductility Elongation in 2 inch percent	Average change of Wght. in percent	Average Corrosive Rate Mil Per Yr.	Loss of Tensile Strength	Ductility Elongation in 2 inch percent
6.1	0.0546	-11.7	41.8	-5.4	0.052	-18.2	33.0	-0.6	0.0051	-0.3	40.3
1.3	0.0289	-9.7	6.2	-2.6	0.0253	-30.5	2.7	-0.9	0.0030	-0.3	12.8
35.3	0.309	-73.1	6.4	-7.1	0.0693	-19.9	19.0	-1.0	0.0088	-0.6	56.8
12.1	1.104	-22.0	23.5	-1.6	0.0155	-3.2	31.0	-0.4	0.0041	-0.2	31.0
13.7	0.120	-52.7	24.8	-1.0	0.0065	11-8	44.5	-0.4	0.0040	-3.0	60.6
7.2	0.0644	-15.7	43.0	-0.9	0.0063	-5.3	35.2	-0.2	0.0020	-0.4	37.3
10.6	0.0883	-18.4	60.2	-9.7	0.0910	-13.2	66.3	-0.5	0.0047	-0.3	67.3

	CORROSION RATE MILLIGRAMS PER SQUARE DECIMETER PER DAY			NOTE
TYPE	NEW YORK CITY	NIAGRA FALLS	WILMINGTON N. CAROLINA	Reference for Stainless Steel & Galvanized Iron "THE CORROSION HANDBOOK" by H. H. Uhlig, P.H.D., Asst. Professor of Corrosion, Mass. Inst. of Tech., Cambridge, Mass., John Wiley & Sons, Publishers
-C.R. 430 interior	-.008 Mdd IN 540 DAYS	-.05 Mdd IN 600 DAYS	-.02 Mdd IN 1320 DAYS	
TYPE -8,-302 exterior	NIL	NO TEST	NO TEST	

GALVANIZED IRON	AVERAGE CORROSION RATE IN MILS PER YEAR			SPONSORED AND REPRODUCED BY SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION 170 DIVISION ST. - ELGIN, ILL.
COMMERCIAL TYPE - .A93	NEW YORK CITY	PITTSBURGH PA.	STATE COLLEGE PA. (RURAL)	
	.13 MILS PER YEAR	26 MILS PER YR	11 MILS PER YEAR	